

FLOOD

Design of a System of Water Supply  
for Springdale Cemetery, Peoria, Illinois

Civil Engineering

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DESIGN OF A SYSTEM OF  
WATER SUPPLY FOR SPRINGDALE  
CEMETERY, PEORIA, ILLINOIS

BY

WILBUR EARL FLOOD

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THESIS

FOR

DEGREE OF BACHELOR OF SCIENCE

IN

CIVIL ENGINEERING

---

COLLEGE OF ENGINEERING

UNIVERSITY OF ILLINOIS

1913



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May 31, 1913.

This is to certify that the thesis prepared in the Department of Municipal and Sanitary Engineering by WILBUR EARL FLOOD entitled Design of a System of Water Supply for Springdale Cemetery, Peoria, Illinois is approved by me as fulfilling this part of the requirements for the degree of Bachelor of Science in Civil Engineering.

Melvin E. Enger  
Instructor in Charge.

Approved:

W. M. Talbot  
Professor of Municipal and Sanitary Engineering.

Approved:

Ira O. Baker  
Professor of Civil Engineering.

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DESIGN OF A SYSTEM OF WATER-SUPPLY FOR  
SPRINGDALE CEMETERY.

LOCATION.

The Springdale Cemetery is situated to the northeast of the City of Peoria and west of the village of Averyville, which at present is one of the suburbs of the city. The cemetery occupies a site of great natural beauty among the high bluffs which overlook the Illinois River.

HISTORY AND DEVELOPEMENT.

In the year of 1867 the State Legislature granted to Henry Lightner and Sons, the original owners of the property now belonging to the Springdale Cemetery Association, a charter permitting the use of this property for burial purposes. This charter states that the cemetery was to be perpetual and should be controlled only by the sole heirs of the late Henry Lightner & Sons. It also states that the ground was to be divided into small lots suitable for the burial of the various families, that these lots should be designated as private lots, also that a portion of the grounds should be reserved for those who can not afford private lots; these were to be designated as public lots. It is also stipulated that all money obtained from the sale of lots should be placed in some reliable bank of the City of Peoria, and the interest on such moneys shall go into a lot fund which shall be for the care and the upkeep of the said lots.

The Springdale Cemetery has developed, and up to the present day 15,000 burials have been made. It has been found that a watersupply is becoming necessary. Until last year no attempt has been made in the way of investigation along this line. Last summer (1912)





it was to the writers' good fortune to be placed in full charge of the engineering work, most of which consisted in making surveys as a preliminary to a design of a system of watersupply.

#### THE PROPOSED SYSTEM OF SUPPLY.

In order to maintain a beautiful cemetery a good sprinkling system is absolutely necessary. The Springdale Cemetery Association maintains a sprinkling wagon which makes two or three rounds per week and two men water all flowers and plants. The owners of lots pay a small fee for this service. Any person not wishing to pay for the sprinkling of the flowers and shrubs upon his lot must carry the water<sup>up</sup> over the bluffs from the creek or from the office building, which is situated at the south entrance of the cemetery. The present system is inadequate and the system of watersupply described in this thesis is proposed as a remedy. It will be the purpose of this thesis to make complete plans and specifications, with working drawings, for a watersupply system for sprinkling this cemetery.

#### THE SELECTION OF THE MOST ECONOMICAL SYSTEM.

At the present there have been two projects suggested for the supplying of water. The first is to buy water from the Peoria Water Company, and the second is to put in a private pumping plant taking water from a small artificial lake on the cemetery grounds.

Calculations as to the annual cost of each of the systems follow.

The Peoria Water Company will furnish water to the Springdale Cemetery at the rate of \$50.00 per month. This includes the laying of the pipe from the mains up to, and connecting to the distribution system of the Springdale Cemetery. Also an extra charge of 6 cents is made per thousand gallons for all water used over a certain limit.



(3)

Note:- The Peoria Water Company will not stipulate the limit unless the Cemetery Association desires to enter upon a written contract.

For the private pumping plant we find that the Peoria Electric Company will furnish power at 5 cents per kilowatt hour. The total cost of pump, motor, and together with complete pumping outfit is estimated at \$800.00 and the pressure furnished at the pumping station is to be 75 lb. per sq. in. Current rate of interest is taken at 5 percent, and the maximum rate of pumping is 200 gallons per minute.

200 gallons per minute, ----- 12,000 gallons per hour.

75 lb. per sq. in. ----- 173 feet. working head.

The amount of work to be done is,  $\frac{62.5 \times 173.00}{7.5} = 1440 \text{ ft. lb. per gal.}$

For 200 gallons per minute the work required,

$200 \times 1440 = 288,000 \text{ ft. lb. per min.}$

T.H.P.

$\frac{288,000}{33,000} = 8.75.$

If the efficiency of the motor and the pump is 50 %, the actual horsepower required is:-

$\frac{8.75}{0.50} = 17.5, \text{ say } 18 .$

18 hp. is equivalent to  $18 \times 746 = 13.41 \text{ kw.}$

If the pump is operated from 2 to 6 P.M. for six months during the year, the cost of electrical current for one year at the rate of 0.05 cts. per kw. hr. will be:-

$11.18 \times 4 \times 0.05 \times 180 = 402.48, \text{ say } \$ 405.00. \text{ which}$   
will be the cost of power.





(4)

The total operating expense is,

Cost of power	\$ 405.00
Oil, Repairs, Fuses, and Attention, etc.	75.00
Total operating expenses.	<u>\$ 480.00</u>

The estimated first cost of the plant is,

Pump motor complete with starting equipment,	
and necessary connecting pipe with valves,--	\$ 800.00
Cost for building,	-- 300.00
Cost of solid concrete dam,	-- <u>405.00</u>
Total	--\$ <u>1505.00</u> say \$ 1500.00.

#### CAPITALIZATION.

The annual expense will be the interest on the first cost, plus the cost of operation, plus the annual depreciation. If we consider the life of the plant as 12 years.

Then,

$D = Cr + O + Pr$ . where D is the annual expense.

$$D = 1500 \times 0.05 + 480.00 + \frac{1500 \times 0.05}{(1 + 0.05)^{12} - 1}$$

$$D = \$ 647.75.$$

The annual water rent charged by the Peoria Water Co. would vary from \$ 600.00 to \$ 700.00.



## COMPARISON.

From the comparison between the two systems of supply, it is evident there is but little difference and the only way is to consider the advantages and disadvantages between the two systems. In the case the Peoria Water Company furnish the supply there would be several advantages. First; a pure grade of water could be obtained at all times and this could be used for both drinking and sprinkling purposes. Second; Extra labor is required to operate the private plant. Third; the amount of supply during the dry summer period is uncertain. Fourth; the distribution pipes are not as likely to be contaminated in case the supply is to be obtained from the water company. On the other hand the city water is cold which is injurious to small plants and shrubs, and second; the water company rates are not definitely known.

As the final decision will be left to the directors of the Springdale Cemetery Association, specifications have been written to cover either case. If the Peoria Water Company supply the water to the cemetery, only the specifications for the distribution system will be needed. If the private system is adopted, complete specifications are given in the appendix for the pump , motor , and dam.





## BILL OF MATERIALS.

Cast iron pipe--4 inch.	10,510 ft.	@ 32¢ per ft.	Total Cost. \$ 3370.00
Galvanized " --2 inch.	5,340 ft.	@ 10¢ per ft.	534.00
" " --1 inch.	6,980 ft.	@ 4.85¢ per ft.	339.00

No. of Pcs.	Description	Size	Wgt. of each	Total Wgt.	Total Cost.
4	1/16 bend	4 in.	55	220	
7	1/16 bend	"	70	490	
6	1/4 bend	"	100	600	
6	tapped tee	4 x 4 x 2	---	---	\$ 30.00
6	" "	4 x 4 x 1	---	---	210.00
3	tee	4 x 4 x 4	125	375	
1	"	4 x 2 x 4	100	100	
3	reducers	4 x 2	45	135	
4	valves	4 inch			30.00
2	valve boxes				20.00
TOTALS.				1,920	51.30

## Galvanized Specials.

6	1/16 bend	2 in.		6	
4	1/8 "	2 in.		4	
15	1/4 "	2 in.		15	
22	1/16 "	1 in.		20	
4	1/8 "	1 in.		3	
50	1/4 "	1 in.		45	
15	tee	1 x 1 x 1		15	
17	"	2 x 2 x 1		17	
6	"	2 x 2 x 2		6	
72	hydrants	1 in.			72.00



## BILL OF MATERIAL ( CONT. )

## Galvanized Specials.

No. of Pcs.	Description	Size	Wgt. of each	Total Wgt.	Total Cost
11	Valves	2 in.		11.0	
1	Reducer	2 x 1		1.0	
TOTALS *				143.0	\$ 13.00
TOTAL COST OF ALL MATERIAL					\$ 4,679.30

## COST OF LAYING. (includes trenching, laying pipe,

and backfilling.)

			Total Cost
Cast Iron Pipe.	(4 inch.)	@ 15.68¢ per ft.	\$ 1,681.60
Galvanized Pipe.	(2 inch.)	@ 10.00¢ per ft.	534.00
" "	(1 inch.)	@ 8.00¢ per ft.	558.40
Totals.			\$ 2,774.00

ESTIMATE. ( DISTRIBUTION SYSTEM )

First cost. -----	\$ 7,453.30
Engineering (6 % ) -----	\$ 450.00
Freight charges. -----	\$ 500.00
Total cost. -----	\$ 8,403.30

## ESTIMATE. ( INCLUDING DISTRIBUTION SYSTEM, PUMPS, MOTOR, AND DAM. )

Total cost. -----	\$ 9,946.00
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## GENERAL CLAUSES, REQUIREMENTS AND PROVISIONS FOR ALL CONTRACTS.

The word 'Engineer' as used in these specifications shall be understood to be the engineer acting as agent for the Springdale Cemetery Association, who shall have the full powers for the superintendence and direction of the work, and for the inspection, acceptance, or rejection of any material or workmanship used in any part of the work.

He shall have the right to dictate how, when or where work shall be done in order that all parts of the work shall progress in proper sequence to the best advantage to the Cemetery Association. In order that no part of the work may be held back because dilatory, perverse, or insufficient measures are taken by any contractor interested in the work of installing the water-works plant, herein described, the engineer may at his discretion employ at the expense of the offending contractor, such labor, equipment or materials, or use such additional labor, equipment or materials as he may find at hand which belongs to the contractor, in such a way as he may deem it necessary to accomplish the work in question, provided; first he shall give written notice to the contractor that such work or designated part of the work should be done within reasonable time specified; and provided further, that the contractor shall have neglected or refuse to take such measures as will accomplish a given part of the work within the time set.

It is further understood and agreed that if, in the opinion of the engineer, submitted in writing to both parties concerned in any contract with the same, the contractor shall be prosecuting the work with an insufficient stock of material or force of workman for the completion of the work within the time set in this contract or the performance of the work is being unnecessarily or unreasonably delayed, or that the work is being executed in bad faith contrary to the conditions of the contract



are being violated or that the contractor has discontinued the performance for five consecutive days without the written direction of the engineer, or that the contractor shall refuse to take out or replace such work as shall be rejected by the engineer as defective and unsuitable, and replace it with work and materials in conformity with this contract, then in such case the engineer, by written notice served upon the contractor either personally or by leaving such a notice at the place of business or with the agent in charge of the work, direct the said contractor to discontinue all work or any part of the work thereof, under the agreement, and said engineer thereupon notify the sureties who are the parties of the bond accompanying the agreement, directing them to proceed with the work or such portion thereof as the contractor may be thus notified to discontinue. Should said securities fail to proceed as notified within ten days after such notice has been delivered to their representative residing nearest to the work, or to their business address, it shall be evidence in fact to the abandonment of the contract; whereupon said engineer shall have power, and <sup>is</sup> hereby authorized to employ by contract or otherwise, and in such a manner and at such a price as he may determine, any person, persons, firm or corporation, to complete the work contemplated in this contract, and at his option to seize upon and use all material found upon the premises of the Springdale Cemetery belonging to the said contractor, and charge the expense of all such contracts, labor, tools, and materials etc., of whatever class and character until after it has satisfactorily completed, to the said contractor, and the expense so charged shall be deducted and paid to the cemetery out of any money which may be due, or which at any time become due to the contractor under this contract, if the same had been satisfactorily completed by them. In case of such expense being less than the sum which would be payable under this contract, if the same had been satisfactorily completed by the





by the said contractor, he shall be entitled to the difference, but if the sum shall exceed that amount which should have been due to the contractor if he had satisfactorily completed the work contemplated under the contract, then the said contractor shall pay the amount of such excess to the cemetery, upon a certificate of such indebtedness as furnished and sworn by the engineer.

The contractor shall afford all reasonable facilities for making inspections and shall promptly and fully carry out the instructions of the engineer as regards to the removal or repair of faulty material or workmanship. In case the instructions of the engineer concerning the workmanship or the materials used or not carried out, the engineer shall have the right to stop any or all work on the contract, until the fault is remedied. If the contractor shall neglect or refuse to remedy the work or workmanship condemned by the engineer, the engineer may cause the condemned portion to be removed by other parties, and assess the cost against the contractor refusing to make the condemned portion good.

Upon all questions concerning the execution of the work, concerning the interpretations of these specifications and concerning the measurement of the work and the classification thereof, the decision of the engineer shall be final and binding.

The engineer shall have the right to require the removal of any workman or workmen on the work, if in his judgment, it shall be to the best interest of the work that such particular workman be removed.

The word Contractor as used in these specifications shall be understood to mean the successful bidder undertaking, for a consideration, to do the work covered by these specifications.

The contractor may designate a foreman, or other representative





to receive instructions from the engineer in his absence, and failing to do so, he will be held responsible for the execution of instructions it may be necessary to give in his absence.

No sub-contractor will be recognized.

The contractor shall maintain such lights, railings, and fences as are necessary for the protection of the public and the laborers.

Should the engineer representing the Springdale Cemetery Association, deem it proper or necessary in the execution of the work to make any alterations which may increase or diminish the expense, such alterations shall not violate or annul this agreement, nor the provisions of the surety.

The contractor shall protect the Springdale Cemetery Association forever, from the costs or any suits that may be brought against the cemetery because of some infringement or alleged infringement of patent rights,

For all work covered by these specifications a bond equal to 50% of the bid price shall be furnished by the contractors during such work, that they shall do well and faithfully perform the work in accordance with these specifications.

All loss or damage arising out of the nature of the work done, or from any detention or from any unforeseen obstruction or difficulty that may be encountered in the prosecution of the work, from the action of the elements, shall be sustained by the contractor.

In case the Springdale Cemetery Association shall deem it necessary to declare a portion or a section of this contract forfeited, it is hereby expressly stipulated, and understood, that such declaration shall not in any way relieve the contractor from the covenants and provisions of the contract, but it shall be valid and binding on the contractor.



The contractor agrees to remove all material and debris on completion of, and be responsible for the work, until the same is finished and accepted by the Cemetery Association.

Extra work shall only be allowed when done in accordance with a written order from the engineer, and shall be paid for as follows:

Extra work of a nature for which a unit price is established for similar work in the bid, will be paid for at a bid price.

Where no bid is given, the work shall be paid for at a cost plus a percent for superintendence and profit. The contractor is to furnish the tools and the machinery required.

The following will be the basis for figuring the price to be paid for such work:

For materials used in construction, -cost plus ten percent.

For labor force account, plus fifteen percent.

The contractor shall show original bill for material and freight.

The manner of doing the work and the determination of the labor-force account cost, will be in the hands of the engineer.





## DISTRIBUTION SYSTEM.

## WORK TO BE DONE.

The work to be done shall include the laying of all water-pipe and accessories, in accordance with the accompanying plats of the Springdale Cemetery. In case of difficulties not shown by these plats of said cemetery or other discrepancies, the pipe shall be laid under the direction of the engineer.

The contractor shall dig the trench and furnish all tools and materials and labor required to lay the pipe line, specials, valves, and hydrants, backfill all trenches, and do all work incident to the laying of the said pipe line, etc., as herein set forth, or as directed by the engineer in charge. The work shall include all delivery of materials, ditching, pumping, draining, and all provisions necessary to protect and maintain, fences, drains, culverts, and other structures, the furnishing and maintenance of suitable bridges and foot-ways across intercepted ways, the clearing away of all rubbish and surplus material, and the furnishing of all materials, tools, fuel, and labor required.

## LOCATION OF PIPE.

In the Springdale Cemetery, the pipe shall be laid so as not to cross <sup>enter</sup> or upon the property of any of the lot owners. When the pipe is laid in divisions where burials are made it should preferably be laid in the center of all walk lines.

## LOCATION OF HYDRANTS.

Hydrants are placed in accordance with the accompanying plats.

## DEPTH OF TRENCH.

The depth of trench shall be at least two and one half feet below the surface of the ground and upon the divisions the depth



should not exceed five feet. This depth applies to all sizes of pipe used.

#### LOCATION OF SPECIALS, VALVES, AND HYDRANTS.

The placing of all pipe, specials, valves and hydrants will be under the direction of the engineer in charge, who will follow as closely as possible, the layout shown on the plan for the distribution system, hereto attached.

#### MATERIALS.

The contractor shall furnish all pipe, valves, hydrants and specials, and the necessary lead and oakum required to make all joints. The materials shall conform to the following specifications;

#### CAST IRON PIPE.

Kind of pipe. All pipe used on this work must conform to the standard specifications of the American Waterworks Association for class B pipe. The above exception, may be either Class A. or Class B. pipe of the same standard specifications.

Each joint of pipe as the above specifications for cast iron pipe state, shall be plainly marked with the makers name, weight of pipe and class letter.

With each shipment of pipe, the contractor shall furnish to the engineer in charge, a certified statement showing the results of the test in bending made upon specimen bars from each melt in the shipment, and he shall further certify that the pipe in the shipment has been subjected without signs of failure to a hydrostatic pressure test of 300 pounds per square inch.

#### COATING OF PIPE.

All pipe and specials must be coated inside and out, in the





manner specified to be done in the above specifications. The pipe line contractor shall take care to preserve this coating intact, so that the metal will not <sup>be</sup> exposed to the rust or tubercular action. Any breaks in the coating shall be painted over with a coal tar varnish.

#### BROKEN PIPE.

Broken or faulty pipe shall not be used for short connections between sound bells. Broken bells shall not be used. In case short pieces are used, they shall be cut off true and square across with smooth edges.

#### SPECIALS.

Specials, (except plugs as noted below) shall conform to the American Waterworks Standards. All tees and crosses shall have all bell ends. Reducers and elbows may be made with bell and spigots, to suit the convenience of the contractor. Reducers shall be made with what is known as the 'long body' pattern.

Plugs shall be what is known as screw, or test plugs, for water pipe. They shall be made with a course thread on the outside of a cylindrical surface, and shall be leaded and chaulked into the bells of the pipe, in the same way as the plain plugs. They shall have lugs on the end, so that a bar may be inserted between them and the plug turned out without melting the lead. Plugs shall fit the bells with the proper space for leading between.

#### VALVES.

All valves shall have bell ends and stationary stem, parallel seat, bronze mounting, and double seat, and shall open easily and satisfactorily by turning to the left. The valves shall offer a free and unobstructed passageway for water when fully opened. They shall be subjected to a full hydrostatic test of 300 lb. per sq. in. before shipment, without damage, or appreciable leakage, and the contractor shall show a certified statement





from the manufacture, that all valves have been so tested. The name of the maker and his catalogue number shall be plainly marked on each side of the valve, and the contractor shall furnish detail drawings on tracing cloth showing all parts of the valve especially the exact shape and size of top nut. All top nuts shall be exactly the same so that the same key will open the valves.

#### VALVE BOXES.

The contractor shall also furnish valve boxes, which shall fit down over the body of the valve, and rest on the horizontal flange of the valve body. The valve boxes shall have the proper length to bring the cap to the surface of the ground. They shall be so adjustable through some vertical distance so that they may<sup>be</sup> accommodated to the inequalities of the ground. They shall be built rugged and strong to withstand the shocks of traffic. The word 'Water' shall be printed in raised letters across the cover.

#### KEY.

The contractor shall furnish three keys or wrenches, for the opening and the closing of the valves boxes, which keys shall be of such a design, size, shape, length and strength, that may be used for opening and closing the valves in the pipe line, without difficulty or damage to the valve nut or key.

#### HYDRANTS.

The sprinkling hydrant shall be strictly first class in every particular, and non-freezing, strong in every part, simple in construction, and shall <sup>give</sup> be particularly an unobstructed flow of water, perform its<sup>work</sup> easily and satisfactorily, under all sorts of conditions of soil and weather, produce no water hammer in closing and remain tight



under all pressures, and shall be arranged that all working parts may be easily accessible. There shall be one nipple for attaching one line of one inch hose. Hydrants must be complete in every detail.

**LEAD.**

The lead shall be first quality, pure, soft, pig-lead.

**GASKET.**

The gasket shall be clean, hemp yarn or oakum, with long fibers, braided and twisted into a loose rope. The yarn shall be delivered on the job in bales or bundles, and shall be kept clean and dry, free from mud and dirt until used.





## BIDS. (Distribution System.)

Bids shall be upon the work and equipment described in the specifications or otherwise shown on the plans, which plans and specifications shall be a part of the contract.

The Cemetery Association reserves the right to let all contracts in part or the whole or to reject any or all bids.

## Distribution System.

Cast iron pipe measured in place.

Class B. 4 inch pipe in place @----- per foot.

Galvanized Pipe measured in place.

Extra Heavy. 2 inch pipe in place @----- per foot.

" " 1 inch pipe in place @----- per foot.

Specials.----- per lb.

Sprinkling hydrants. 1 inch.----- each.

Valves;(including valve boxes) 4 in.----- each.

Valves;(for drains) 1 inch.----- each.



## CONSTRUCTION METHODS.

## TRENCHING.

All trenching shall be in open cut from the surface of the ground. The bottom of the trench shall be formed so as to allow an even bearing along the length of pipe. The bottom and the sides of the joints, shall be dished to receive the bells of the pipe, and allow ample room for caulking the joint. The material excavated shall be laid compactly along the sides of the trench, and kept trimmed so as to be of as little inconvenience<sup>or</sup> as possible to the travelling public. The trench shall not be opened for more than 1000 ft. ahead of the connecting pipe ( not including the back fill ) without the permission of the engineer.

## WATER.

The contractor shall keep the trench free from water during the construction work. He shall provide proper outlets for all water courses and drains intercepted during the progress of the work, and replace them in good condition as he found them.

## PRIVATE CROSSINGS.

The trenches shall be bridged in the proper and secure manner by the contractor so as to prevent serious interruption of the travel upon the public driveways, and afford all necessary access to the public and private premises.

## DELIVERY OF PIPE.

The pipe , specials, <sup>and</sup> valves shall be delivered by the contractor along the pipe line trench in such a way as to prevent



damage to casting or coating. All necessary handling shall be obviated as far as possible.

#### PIPE LAYING AND JOINTING.

The pipe shall be cleaned <sup>and</sup> lowered carefully in the trench. It shall be laid that there will be a uniform space around the spigot, in all parts of the hub. The spigot of the pipe shall be laid so inserted to the full depth of the hub at the last section, and shall be held in position while the joint is being made. The joint shall be made tight by means of the oakum and lead. Strands of the oakum (jute) shall be twisted in lengths long enough to reach around the pipe and be caulked into the joint not exceeding  $2\frac{1}{2}$  inches. The caulking shall be well done that the oakum will be compressed further by the caulking the lead. Molten lead shall be poured into the joint at one run and shall be caulked with suitable tools to produce a joint to the required tightness. The lead after caulking shall be flush with the face of the hub and shall extend into the joint at all places at least  $1\frac{1}{4}$  inches.

Whenever pipe is to be cut the work is to be done by the contractor, without extra compensation, in a manner satisfactory to the engineer in charge.

#### PLACING OF THE HYDRANTS.

The contractor shall place all hydrants.

#### BACKFILLING.

Up to the middle of the pipe, clean damp earth, shall be thoroughly tamped in a layer not to exceed three inches thick. No stone





bricbats, or trash shall be placed near the pipe, nor shall trash of any kind be put in the trench anywhere.

#### TESTING.

The water mains shall be tested in 1000 ft. sections as completed. The test shall be made where possible before the trench is backfilled. All leaks shall be stopped, and all defective pipes or valves shall be taken out and replaced; after which the pipe shall be retested till all the leakage has been stopped. The pipe laying shall proceed in such order that these tests can be made consecutively from the pump house <sup>or supply</sup> to the remotest part of the distribution system.

If a source of supply can not be attained when the line of pipe is ready for test, the engineer will, after making an inspection and finding everything in good condition, give the order for the contractor to proceed with the backfilling. This will not preclude an acceptance test to be made whenever the pumps have been made ready for operation, and the defects in the pipe, valves or joints showing up at the time of the test shall be made good.



## GENERAL PLAN AND OPERATING CONDITIONS FOR WATERSUPPLY.

For the information of pump manufactures, and bidders in general, it is thought best to give the following data in regards to the conditions under which this plant must operate and the possible character of the water to be handled.

The source of supply is from an artificial lake covering 0.47 acres which will store up 770,000 gallons. This lake will be supplied from a nearby stream across which will be built a small dam 30 ft. in length. The water stored up by the dam will flow through 192.0 ft. of 8 in. pipe on a 0.52 percent grade to the inlet of the lake when it has reached the surface of the overflow.

This stream will supply<sup>1</sup> water from a drainage area of about one square mile of very rolling country, mostly of timber land. In general the tributary drainage area is characterized by a yellow clay soil interspersed slightly with gravel.

The water will be pumped by a 4 inch, two stage, centrifugal pump against a working head of 175 feet, directly into a 4 inch main, which will distribute water to all parts of the cemetery. The minimum pressure at the highest elevations in the grounds is not to be less than 25 lb. per sq. in.

The water is to be taken from the lake at a distance of 2 ft. 3 in. below the floor of the pump house. From here it will be pumped directly into the mains. The floor of the pumping station will be at an elevation of 155.0 ft., or 3 ft. below the ground surface. The accompanying sketch on page shows the arrangement of the inlets and the outlets pipes and also the connections to the pump.





The electric current to be furnished by the city will be 60 cycle, single phase, taken from residence wires and will be changed to 220 volts at the motor. These wires are to be placed underground from the Perry St., entrance to the Cemetery to the pumping station, this distance being 2000 feet.

The pump in actual daily service will operate during the afternoons from 2 P.M. to 6 P.M. The system of waterworks will operate from the first of April to the first of October.

Provision shall be made to start and to stop the motor, and also a hand primer or some other sufficient method must be provided to prime the pump.



## GENERAL SPECIFICATIONS FOR CONCRETE.

These specifications for concrete materials to be used in mixing the concrete materials apply to the construction of the solid concrete dam and also to the placing of the foundation of the pumphouse.

The building of the pump house will be let under a entirely different contract and only the setting of the pump equipment on a suitable foundation will be required under this contract.

## CEMENT.

The cement used shall be of a standard brand of Portland Cement, conforming to the specifications adopted by the American Society of Testing Materials on August 16, 1909. It shall be delivered on the ground in the standard packages or barrels, with the name of the manufacture plainly marked thereon, and it shall be properly housed until used, so that it shall neither draw dampness nor be spoiled by rain.

## SAND

The sand shall be clean, sharp, and coarse, and shall be free from loam or other deleterious material.

## AGGREGATE.

The aggregate shall be made of durable particles which are in no way to be affected by the cement, air or water. It shall be free from loam, dirt, and other deleterious materials. It may be clean gravel, well graded, crushed rock or chats. In no part of the work shall any particle be larger than will pass through a  $2\frac{1}{2}$  inch ring, and the floors and the other thin slab work, no particle shall be larger than will pass a 1 inch ring.

In case the particles passing a  $\frac{1}{2}$  screen exceed 40 % of the total volume of the aggregate, sufficient coarse material shall be added to reduce the voids to a minimum.



Particles passing  $\frac{1}{4}$  inch screen will be considered sand, but shall be well graded in sizes. In case the size of particles passing the  $\frac{1}{4}$  inch screen are mostly of one or two large sizes, with not sufficient fine material to fill the voids, it will be necessary to add either more or fine sand in order to make up the deficiency in sizes.

#### PROPORTIONS.

Unless otherwise stated here<sup>e</sup>in<sub>A</sub>-after, proportions will be determined in such a way as will reduce voids to a minimum, that is the grading of the particles shall be such that the sand will a little more than fill the voids in the aggregate, and the cement will little more than fill the voids in the sand. When proportions are given in terms of cement to sand and aggregate, it shall be understood to mean that the sand and aggregate bear the relation to each other that the resultant is well graded, and the total mixture of sand and aggregate is meant by the second figure in the ratio.

#### MIXING.

The concrete may be mixed by hand, a water tight turning board shall be used and the ingredients mixed as follows: the proportional part of sand shall be spread out in a thin layer upon the mixing board; the proportional part of cement shall then be spread over the sand in a uniformly thin layer, the materials shall then be turned twice dry and then be spread out over the sand in a uniformly thin layer; the aggregate shall then be added in the proper quantity<sup>t</sup><sub>A</sub> over the cement sand layer, and the whole be turned twice dry and twice wet.

In mixing the ingredients, two men shall start at





the end of the baard, one shoveling right handed and the other shoveling left handed. They shall cut under the material, clean through to the center, and pile the material in a windrow behind them. The shovel shall be handled in such a way as to give a complete blend of the material.

Only so much water shall be added as will make the concrete quake like liver. Care shall be taken in adding the water, that the cement is not washed out.

In taking the concrete from the place of mixing to the place of deposite, care should be taken that the ingredients do not become seperated; first by the judicious addition of the proper amount of water. when mixing, and second; by the expeditious handling of the concrete after mixing.

#### MEASURING OF MATERIAL.

All concrete shall be measured in a bottomless box, in a way approved by the cemetery engineer. The method of measuring shall insure accurate measurement and inspection.

#### RETEMPERING.

No retempering of the concrete will be permitted.

#### FREEZING TEMPERATURES.

In freezing weather the contractor shall take such percautions as will prevent the concrete from freezing. Any frozen concrete shall be replaced, free of cost to the cemetery.

#### PROTECTION AGAINST WIND AND SUN.

The concrete shall be protected against the action of the wind, sun, or rain.



**SURFACE FINISH.**

All exposed surfaces shall be smooth hard impervious surface.

**FOUNDATION OF PUMP HOUSE.**

A four inch floor shall be laid over the entire area inside the building, except where otherwise covered by the pump and the motor foundations. It shall conform to the following requirements.

**SUB-BASE OR FOUNDATION.**

The ground inside the building shall be graded off to a subgrade surface approximately 8 inches below the finished surface of the floor. All holes or soft spots below this sub-grade shall be cleaned out and the entire surface brought up to within four inches of the finished surface of the floor, by tamping cinders or gravel, well wetted and compacted.

**CONCRETE BASE,**

Upon the sub-base as prepared as above specified, shall be laid a course of concrete,  $3\frac{1}{2}$  inches in thickness, well tamped and rammed into place, using  $1\frac{1}{2}$  bbls. of concrete, to each cubic yard of concrete in place. The materials used shall conform to the general specifications for such materials.





**SPECIFICATIONS FOR CONCRETE DAM.**

Excavation is to be made for the foundations of the masonry structure of the dam, and for any grading above or below the dam, or for any other work in connection with the dam, but no payment will be allowed for earth or other excavation unless staked out by the engineer. The price bid for the dam will include the cost for excavation which will cover all excavations made by the contractor for his own convenience or for temporary or protecting work, all of which will be measured and estimated by the engineer.

Earth excavation will be made in accordance with the lines established by the engineer.

**FOUNDATION WORK.**

The foundation work of the masonry dam is to be extended to such a depth and in such a manner as ordered by the engineer. In case of bad bottom piling may be ordered driven under the center line of the dam.

**PROTECTION WORK.**

The contractor will be required at his own expense to take care of all water which may come down the stream during the progress of the work, and to make good any damage done to the dam from freshets or other action of the water or elements.

**PLAN TO BE FOLLOWED.**

The cross section of the dam is shown on plates Nos. 2 & 3, of the working drawings.

**CONCRETE WORK.**

The specifications for concrete work will apply here.



**PUMPING MACHINERY AND ELECTRICAL EQUIPMENT.****PUMP.**

(Bidders should read the first part of the specifications in regard to the water system planned.) Bidder shall furnish in duplicate, details plans and specifications for the pump that they agree to furnish, and install complete with piping, under this contract. These plans and specifications shall show the details of the construction of the pump, including the dimensions and materials to be used, as well as showing the size and the dimensions of the concrete foundation that will be necessary. These plans and specifications must be in the hands of the engineer, at least ten days before the opening of the bids, and in so far as to the material of the construction of the pump is concerned, shall be made part of the contract, subject to these general specifications as herein written.

**TYPE OF PUMP .**

The pump shall be two stage, centrifugal pump, with horizontal shaft and enclosed impellers, direct connected to an induction motor. The capacity of each pump shall be at least 250 gallons per minute, against a head to give the best characteristics with the greatest economy of power and attendance under the above conditions stated.

**EFFICIENCY.**

The bidder shall state in his specifications with what efficiency he will guarantee for the pump when operating under a head of 175 feet, and delivering 200 gallons per minute.

NOTE;- The contractor furnishing the centrifugal pump shall guarantee



the maximum horse power required to drive the pump under the above operating conditions.

#### SPEED.

The speed at which the pump is to be run is to be stated by the bidder in his specifications.

#### CASING.

Provision shall be made in the construction of the casing so that easy access be had to the exterior of the pump, without disturbing the discharge or inlet connections. The casing shall fit true and tight , so that there will not be no leakage of air or water, nor difficulty experienced in replacing after it had been removed. It shall be of form as to give the least hinderance to the passage of the water through it, and shall be of ample strength to withstand all pressures subjected to its service. There shall be made provision by means of a pet cock, or other contrivance, to release any air that may become entrapped within.

#### BEARINGS.

Bearings shall be of a ring oiling type, and of ample size to prevent excessive wear.

#### STUFFING BOXES.

Stuffing boxes shall be of a approved type, and shall prevent leakage of either air or water. They shall be designed as to be easily replaced or repacked, when necessary.

#### UNBALANCED PRESSURES.

The pump shall be designed that it will automatically take care of the unbalanced pressure, and end thrust, under any possible working heads herein mentioned without increasing the bearing friction,





or in any way decreasing the guaranteed efficiency.

#### IMPELLERS.

The impellers shall be the enclosed type, carefully designed and adjusted for the rotative and hydraulic balance. The interior walls shall be gradual in the change of direction and section, smooth and polished in surface, and of such hard material as will prevent excessive wear and abrasion.

#### PRIMER.

The pump shall be furnished with a suitable appliance for the priming of the pump.

#### BASE PLATE.

The pump contractor shall furnish a suitable bed, or base plate, which shall extend to receive the motor. The contractor shall mount the motor on the base.

#### COUPLER.

The flexible coupler between the motor and the pump shall be of a pin and endless belt type, of ample strength so as to transmit the load, and shall be designed for flexibility and ease of dismounting. The coupler shall be properly fitted to the shafts of the motor and pump, by the contractor.

#### PAINTING.

The pump shall be properly painted and enameled, in the same color as the motor, if convenient, otherwise the painting shall be done in any good color, of good durable metal paint, or enamel.

#### PIPE AND VALVE FITTINGS.

The pump contractor shall furnish and install all pipe and valve fittings inside the pump house. He shall submit piping



arrangements diagrams to the engineer for his approval; the piping system designed shall be such as will reduce all elbows to a minimum and will give the least friction loss. The pipe may be either of cast iron, wrought iron, or steel, flanged and accurately fitted and set up. Increasers shall be of long body pattern, and the elbows and tees shall be of a long sweep radius type.

Valves shall have a rising stem and parallel seat, bronze mountings, and a double seat, and shall have ample strength to withstand all pressures to which they were subjected. Valves shall open by turning to the left. The makers name and the catalogue number shall be plainly marked on the valve body. Packing between flanges shall be sufficient to prevent leakage of air and water.

#### INSTALLING OF THE PUMP , PIPE AND MOTOR.

The pump contractor shall set up the pumps and the motors on the foundations, and fit up the piping inside the building. He shall be required to wire the motor, however, as this can not be done by the electric company.

#### TESTS.

Tests of pump installed in place shall be made in presence, and under the supervision of the engineer. Suction and pressure heads shall be measured by standardized guages, attached to the pipe near the pumps, and discharges by nozzles in hose attached to the hydrant which will be placed near the plant, or it may be measured by some other approved method.

#### MOTORS.

The motor shall be a 18 hp., single phase, 60 cycle, 220 volt, squirrel cage type, in running condition, induction motor,





conforming to the test, to the guarantee given, when tested according to Standardization Rules of the American Institute of Electrical Engineers, as approved by the Board of Directors, in June 1911.

The starting box shall operate automatically, and shall return to a off position, whenever the current is cut off. It shall cut down the starting current to not over 150 percent of the full load current, when operating under the normal conditions of running. It shall work smoothly and accurately, at all times, without excessive heating, or accident to itself or any other apparatus.

A triple pole, double throw switch shall be furnished by the pump contractor, and be placed in a convenient place in the panel.

#### PANEL.

A panel of suitable material and design or other acceptable mounting to accomodate the electrical devices furnished for the inside of the building, shall be supplied and fitted by the pump contractor, furnishing the starting equipment.



BIDS.(Pumping machinery,electrical equipment,concrete dam, foundation for pumping station.)

Bids for pumping machinery and for electrical equipment,concrete dam,and foundation for pumping station,shall be made as here indicated but the cemetery in letting the contract will follow what arrangement it sees best,the form here below given,be merely used as a guide to determine the cost of the equipment when furnished in several different ways.

Bids shall be on the following parts of the water-works plant as follows;

Machinery and electrical equipment.

1.(a) Centrifugal pump complete with cast iron base under pump and motor,and all flange pipe and valves,furnished and fitted. The pump contractor to mount the motor which shall be furnished by him.

1.Complete as above with bronze impellers.

2. Complete as above with cast iron impellers.

b. Motor f.o.b. factory.

c. Switchboard complete with starting box.

NOTE; The Peoria Electric Company is to furnish all the wire used for connections and do all the outside wiring.

Foundations for pumping station and under pump .

The bid for setting the foundation for the pump-house and under the pump shall be on a lump sum basis.

Solid concrete dam.

The bid for the construction of the solid concrete dam with a suitable foundation will be on the lump sum basis.



DRAWINGS (Plan followed.)

The system of plats for the various divisions of the cemetery as here given from pages Nos. 36 to 61, show the location of the walk lines with reference to the road lines.

The division plats numbers are placed in red ink on the general plat No. 65, and also each portion of the distribution system shown on the division drawings is shown complete on the general drawing.

On the division drawings the heavy red lines indicate 4 inch cast iron pipe, the medium red lines indicate 2 inch galvanized pipe, and the fine red lines indicate 1 inch galvanized pipe. The circles shown in red ink represent that sprinkling radius which can be obtained with a 75 ft. length of hose.







The Glen  
Plat No. 1-A

$\frac{1}{8}$ B to pumping station

Lake

tapped tee 4x4x1" 25  $\frac{1}{4}$ B

20x

20x

tapped tee 4x4x1"

60  $\frac{1}{4}$ B

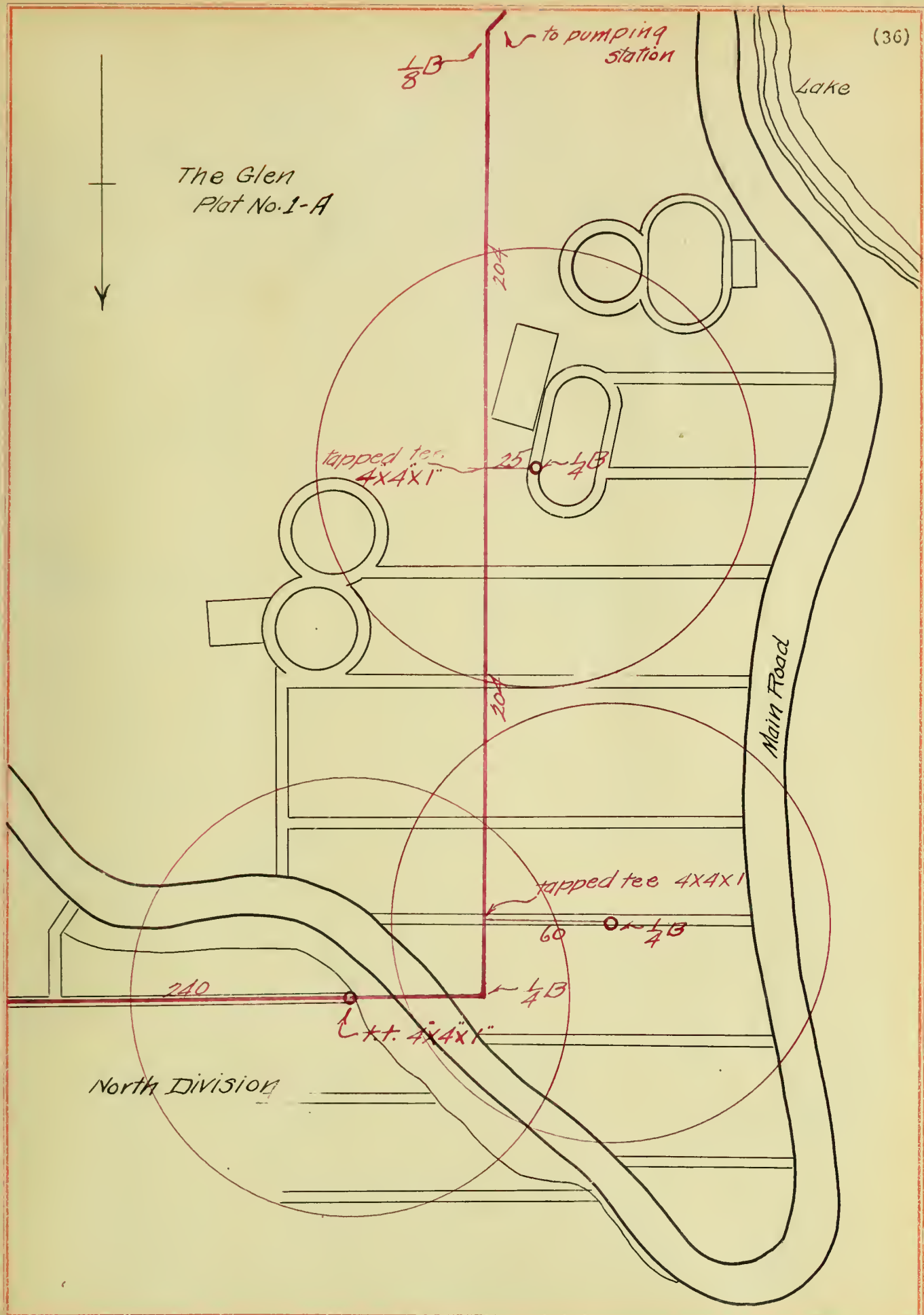
240

$\frac{1}{4}$ B

4x4x1"

North Division

Main Road







THE  
LIBRARY OF THE  
MUSEUM OF MODERN ART

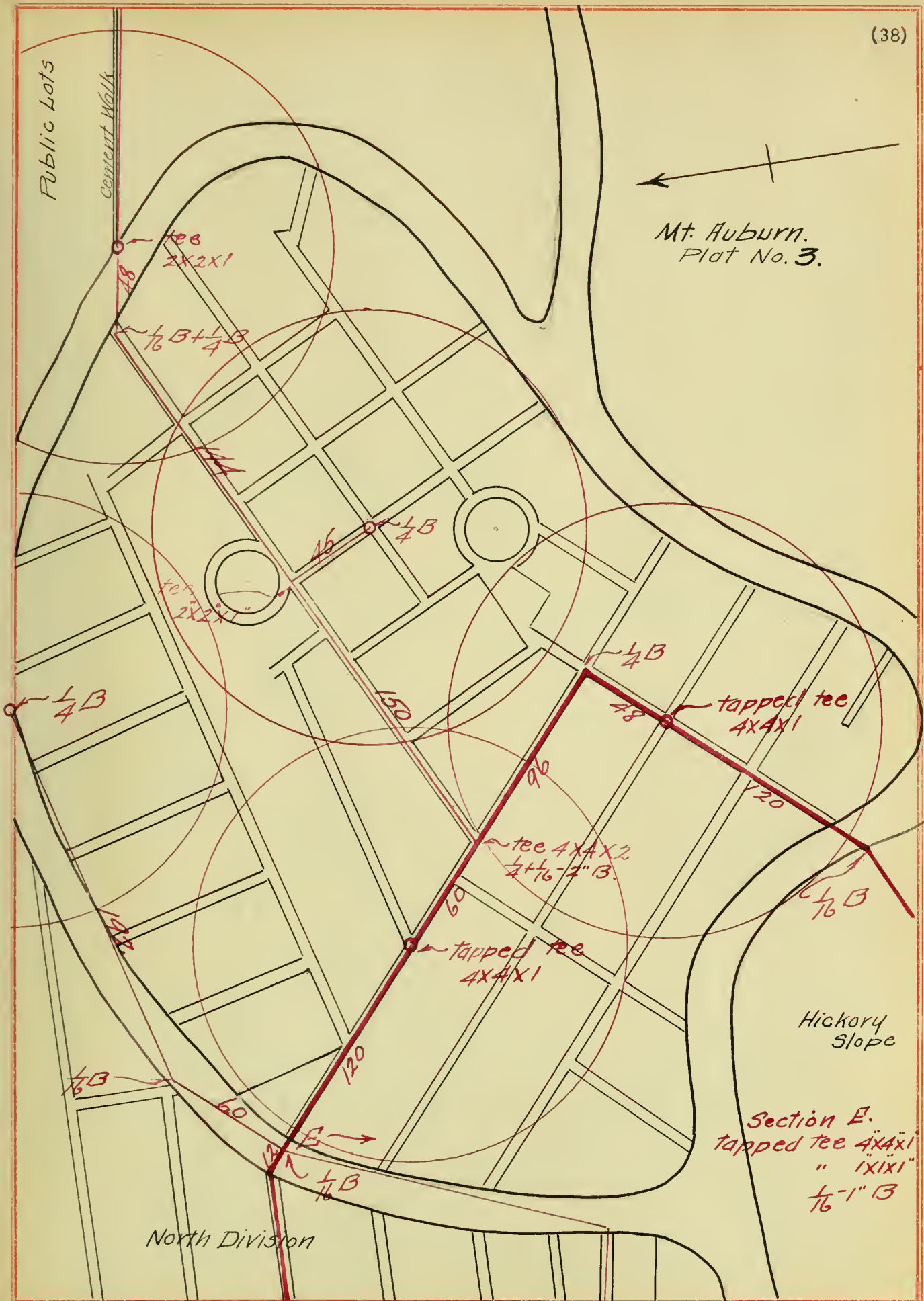


Public Lots

Cement Walk



Mt. Auburn.  
Plat No. 3.

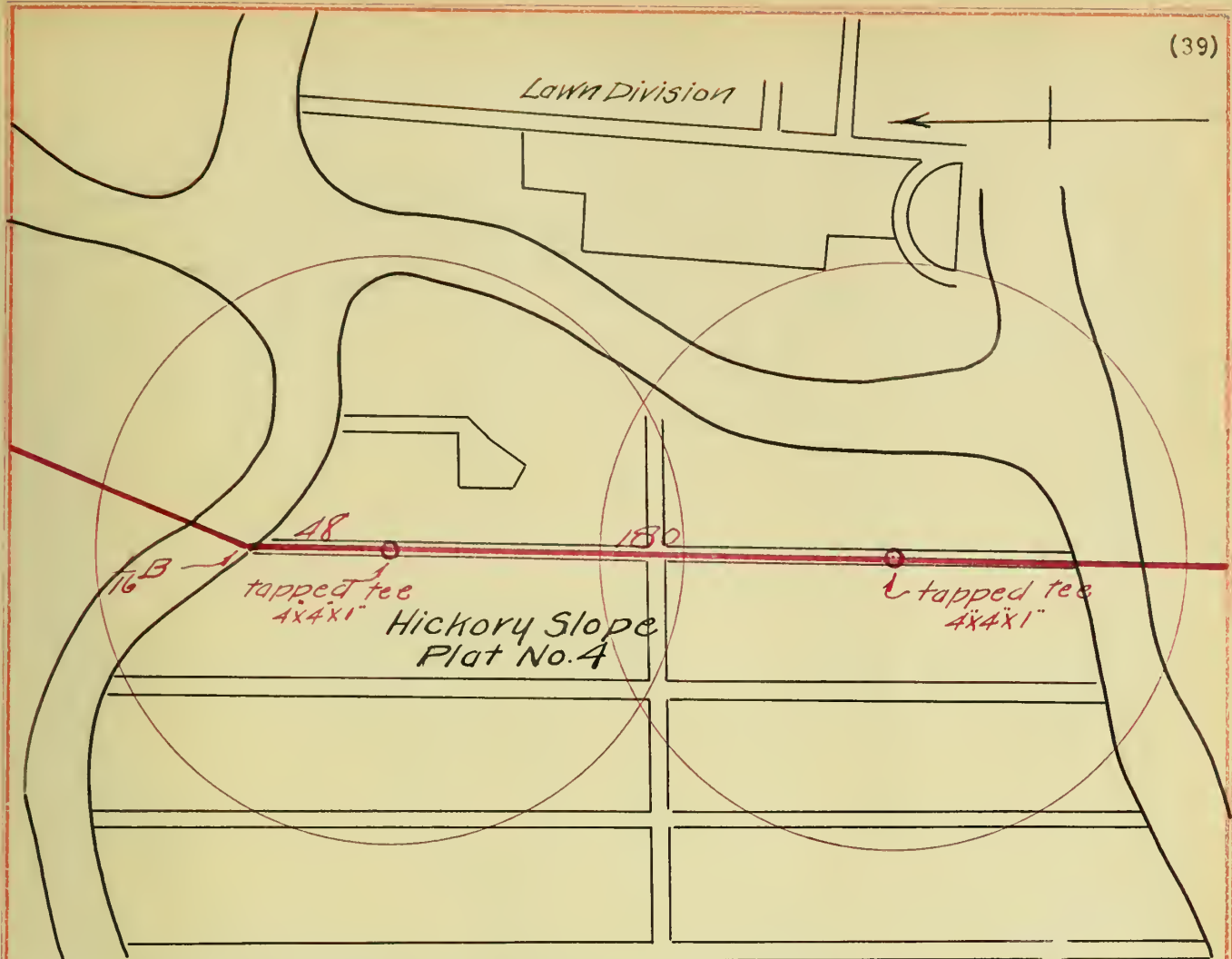


Hickory  
Slope

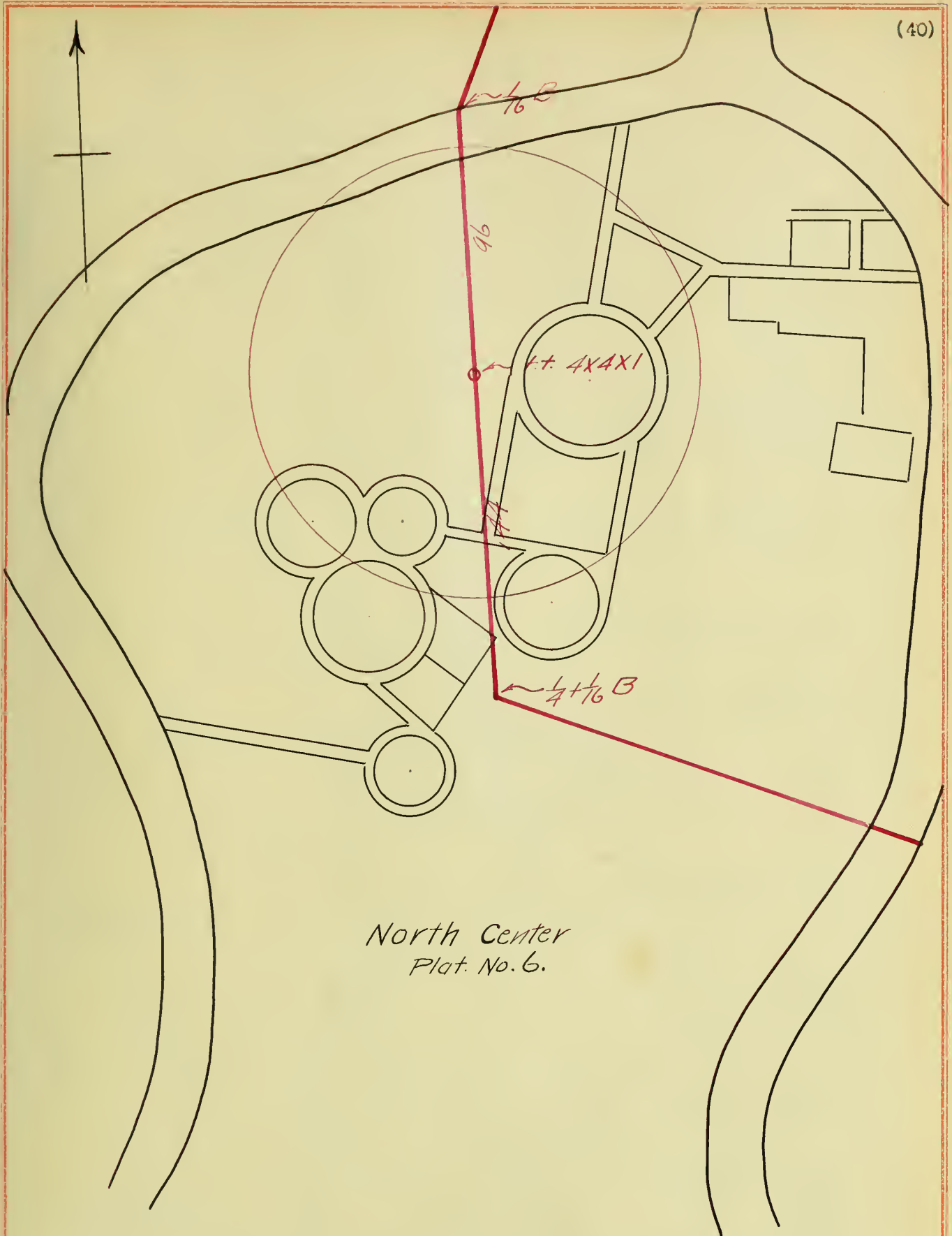
Section E.  
tapped tee 4x4x1  
" 1x1x1  
1/16 - 1" B

North Division









North Center  
Plat. No. 6.



1

THE  
OF THE  
ALL IN ALL

A hand-drawn map of a golf course layout, likely a fairway or green area, showing various features and measurements. The map is oriented with North at the top, indicated by a compass rose in the upper right corner labeled (41).

Key features and labels include:

- Hickory Slope:** Located in the upper left corner.
- North Center:** A label on the left side of the map.
- Lawn Division Flat No. 7:** A central feature, possibly a green or fairway, with a small circle labeled "tee IXIXI" nearby.
- tee IXIXI:** A small circle labeled "tee IXIXI" near the center of the map.
- tee 4X4X1:** A small circle labeled "tee 4X4X1" near the bottom left corner.
- tee 4X4:** A small circle labeled "tee 4X4" near the bottom right corner.
- Mt. Repose:** A label at the bottom center of the map.
- Fair View Lawn:** A label on the right side of the map.

Measurements and dimensions are marked throughout the map:

- 120:** A measurement along a vertical line near the top center.
- 108:** A measurement along a horizontal line near the center right.
- 115:** A measurement along a vertical line on the right side.
- 293:** A measurement along a vertical line on the right side.
- 180:** A measurement along a vertical line on the left side.
- 240:** A measurement along a horizontal line at the bottom.
- 96:** A measurement along a horizontal line near the bottom right.
- 12:** A measurement along a vertical line near the bottom right.
- 120:** A measurement along a vertical line near the bottom right.

Other markings include several red circles and lines, possibly indicating boundaries or specific points of interest. The map is drawn on a grid of lines, with some areas shaded in light green.

LAWN DIVISION  
Plat No. 7

North Center

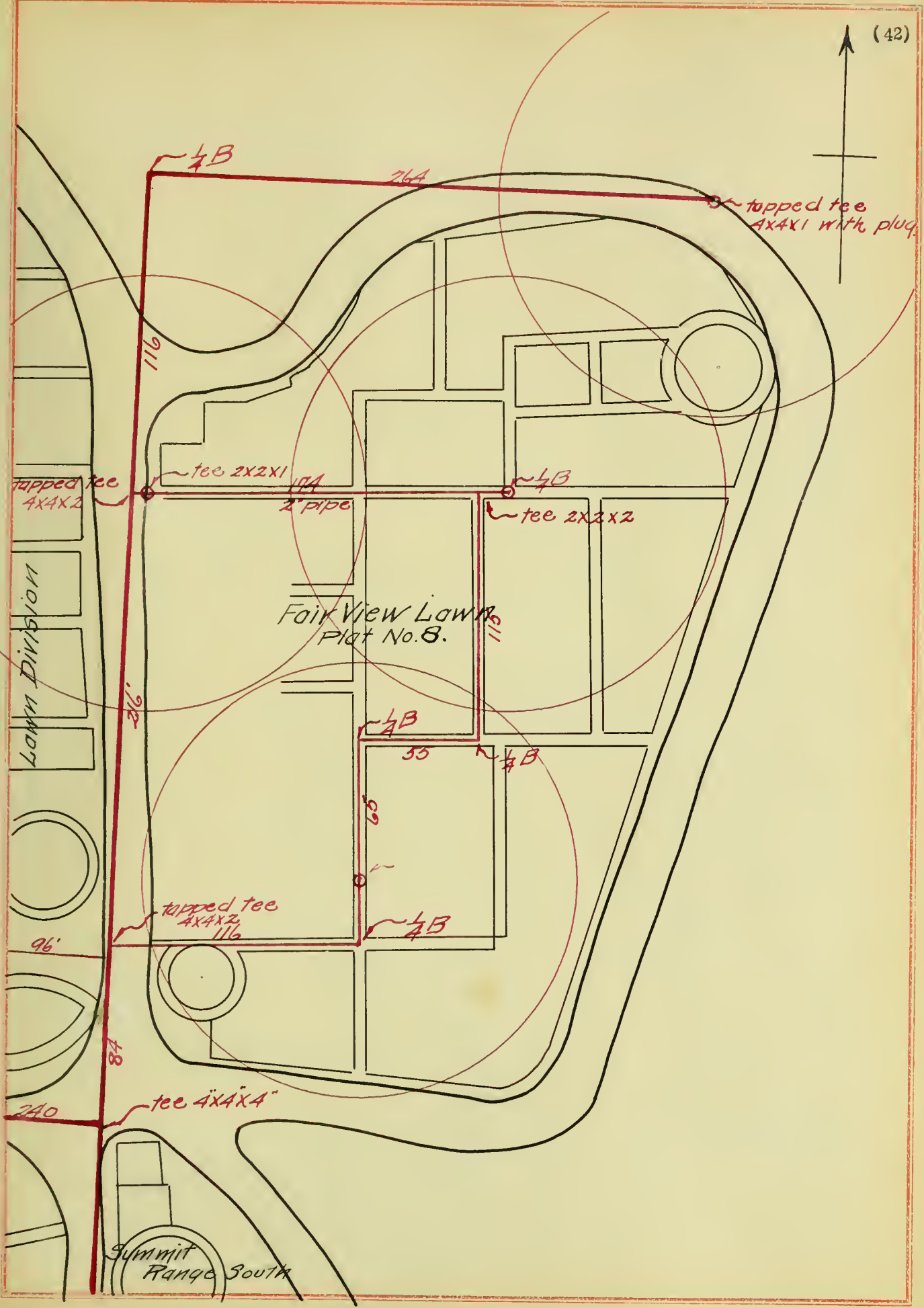
Fair View Lown

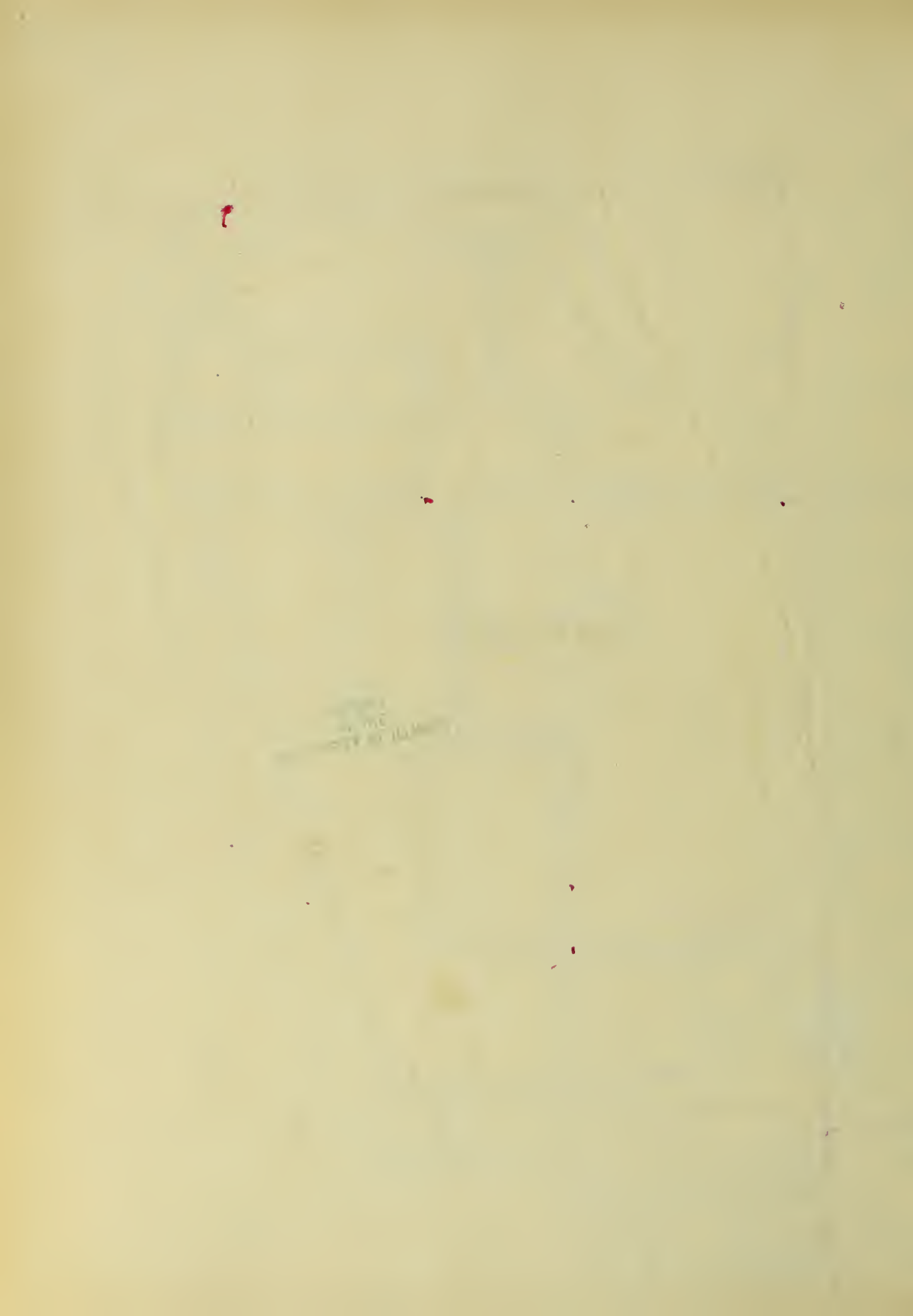
tapped  
tee 4x4x1

Mt. Repose

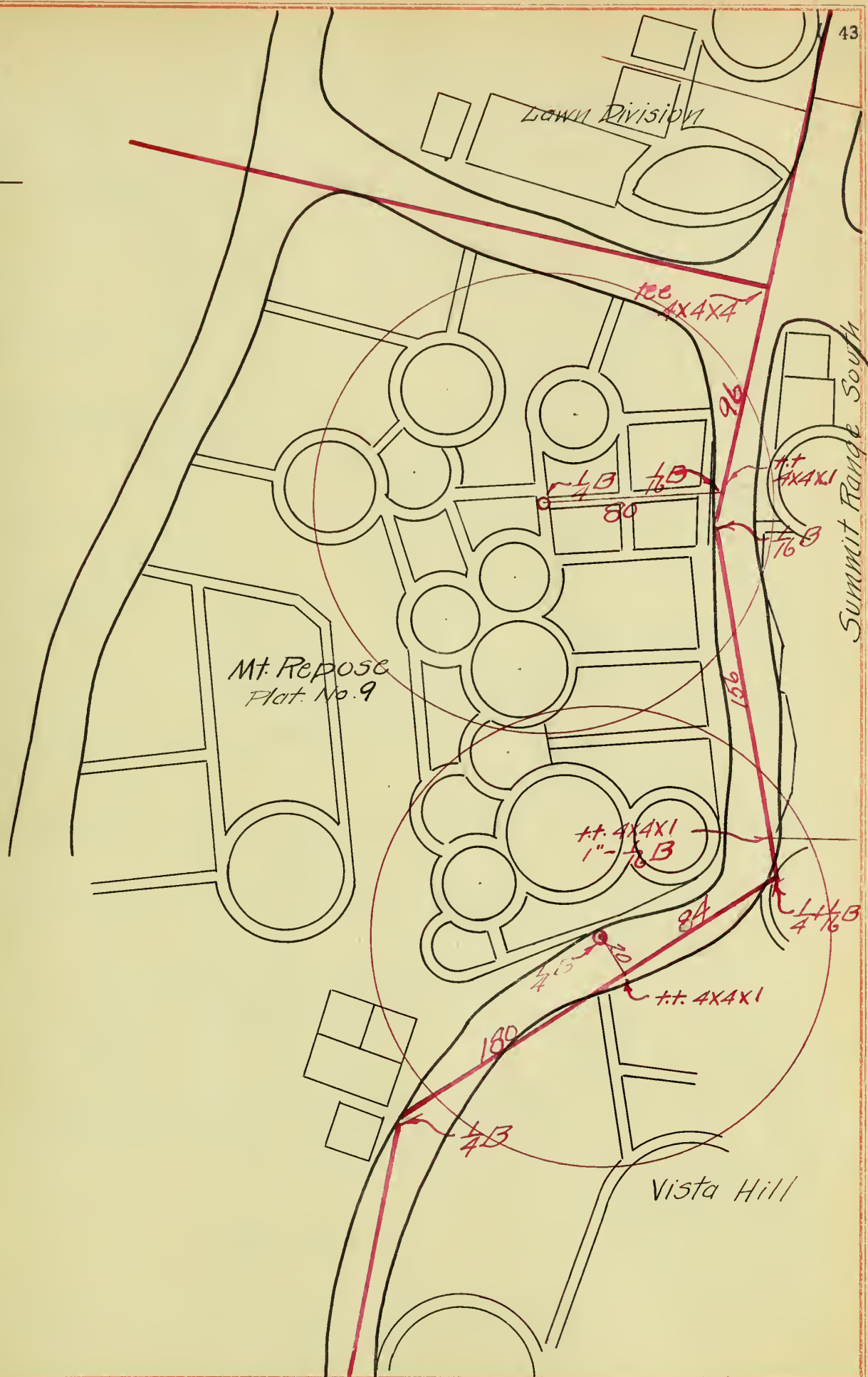
100 4x4







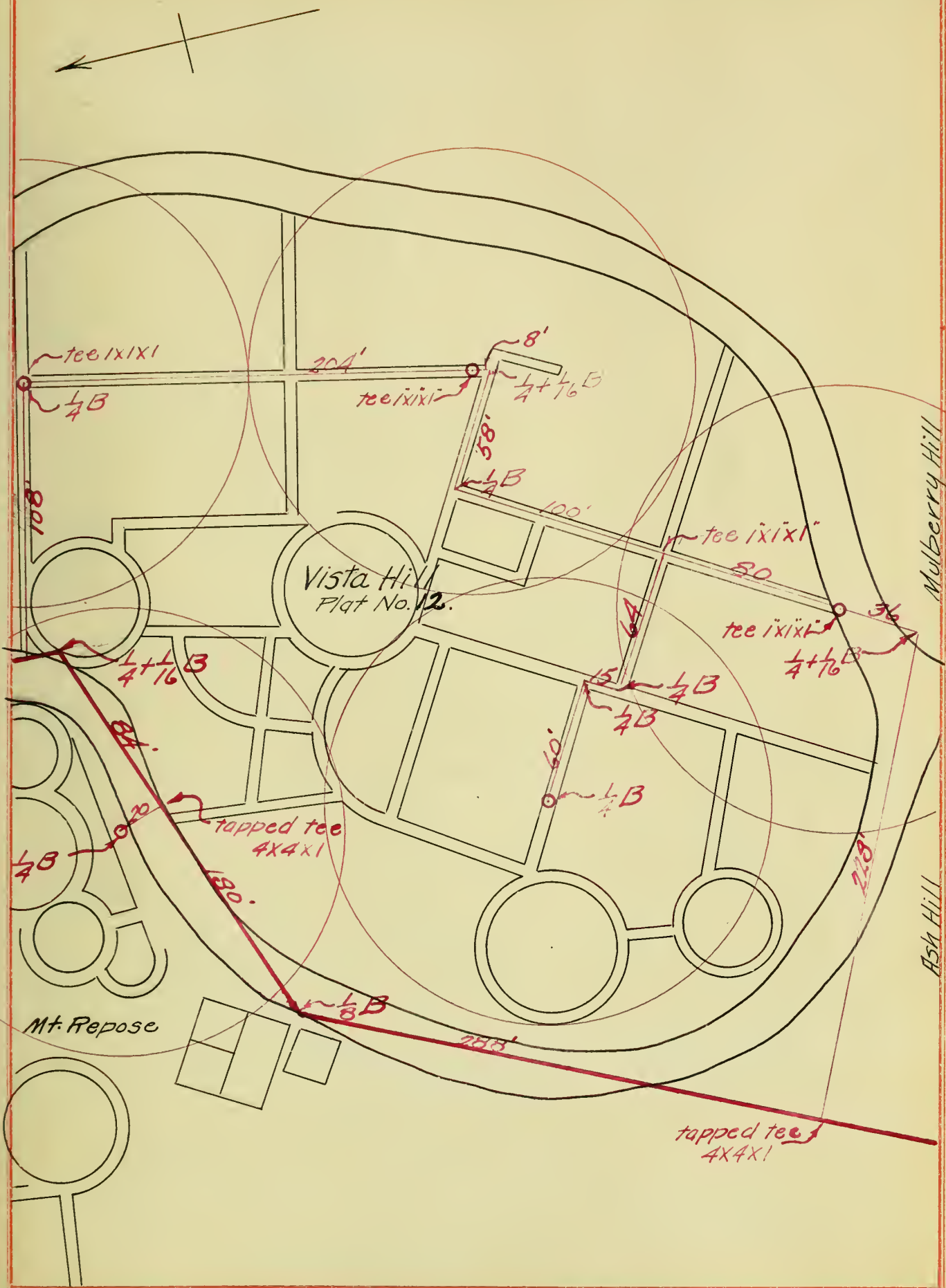






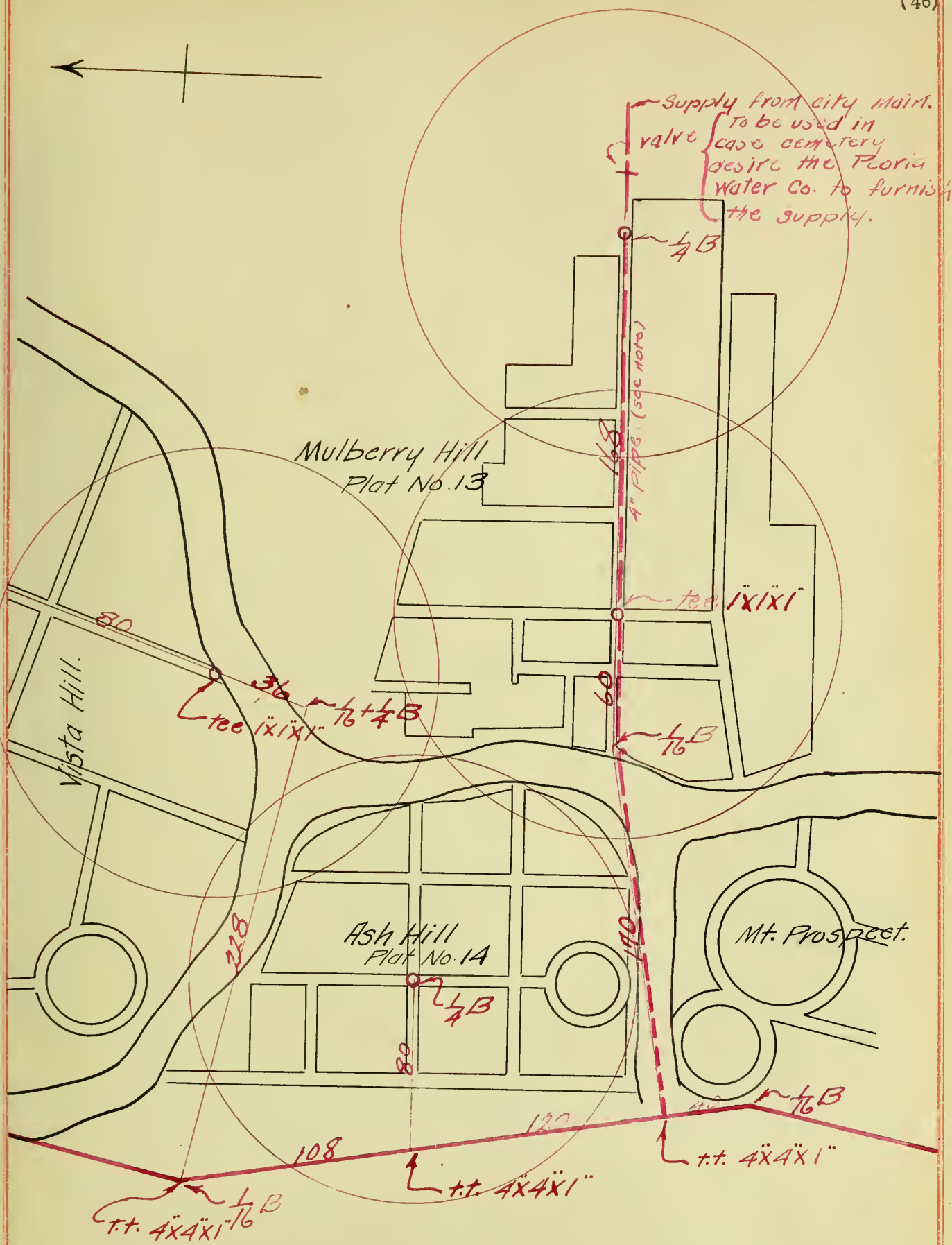




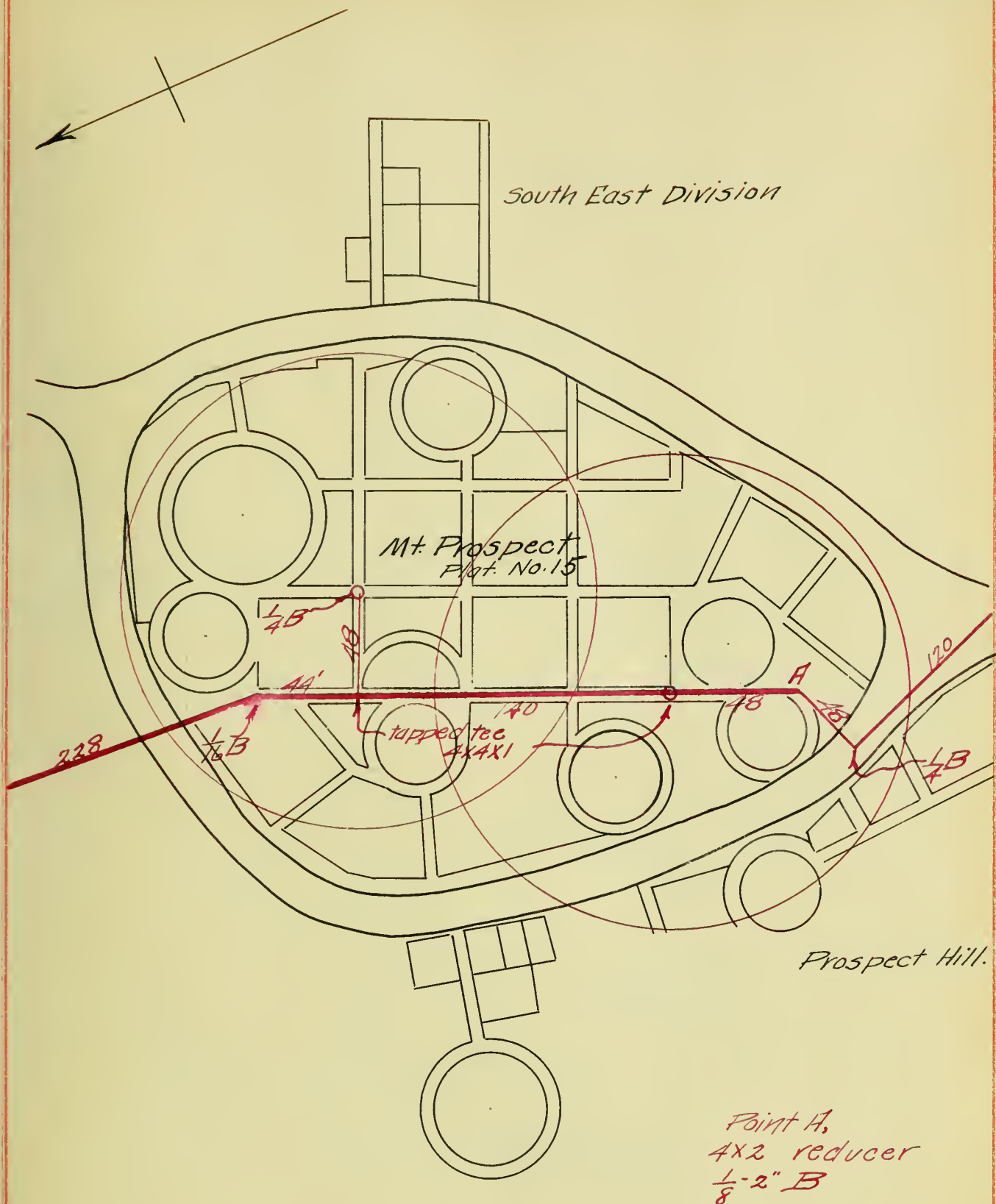






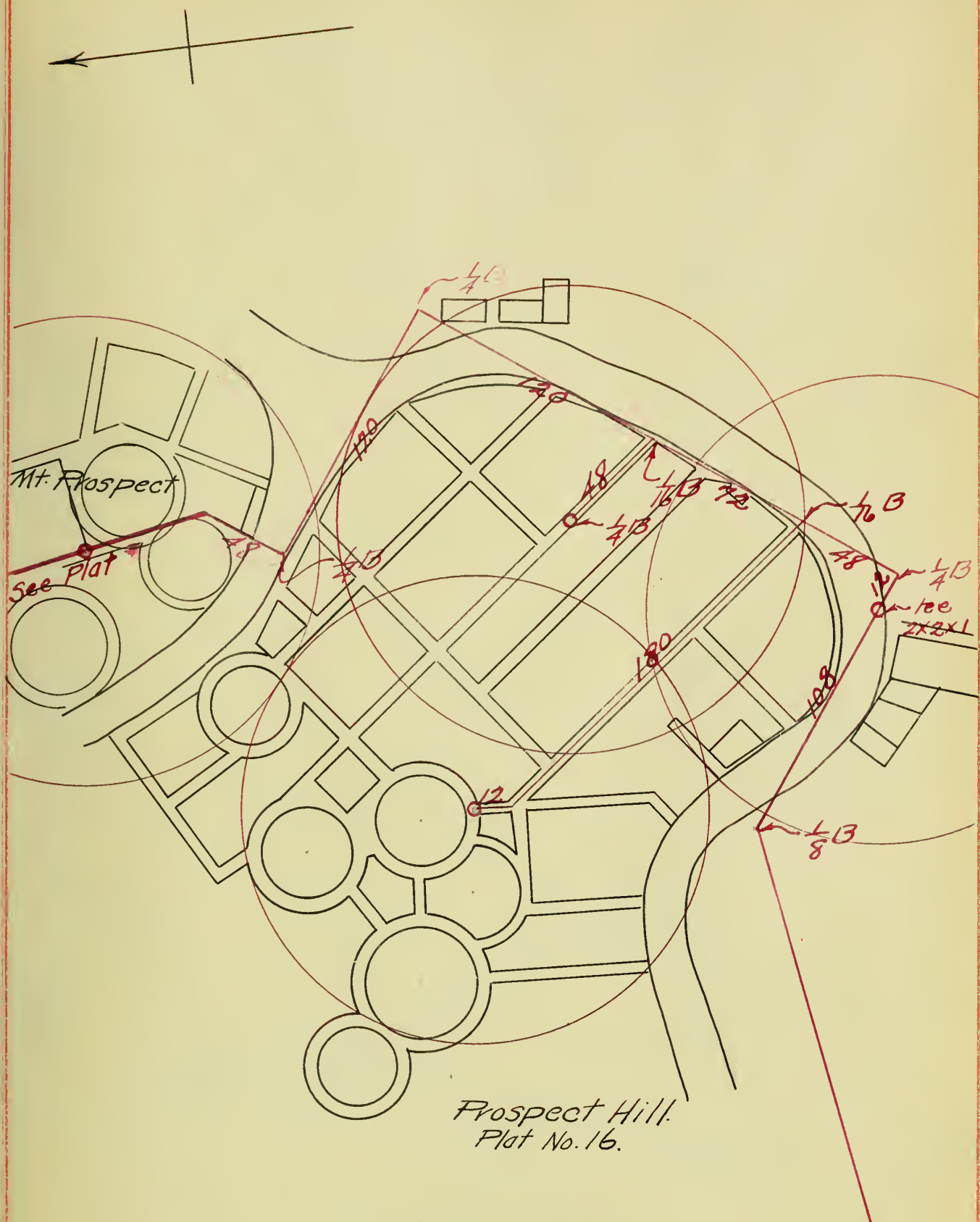




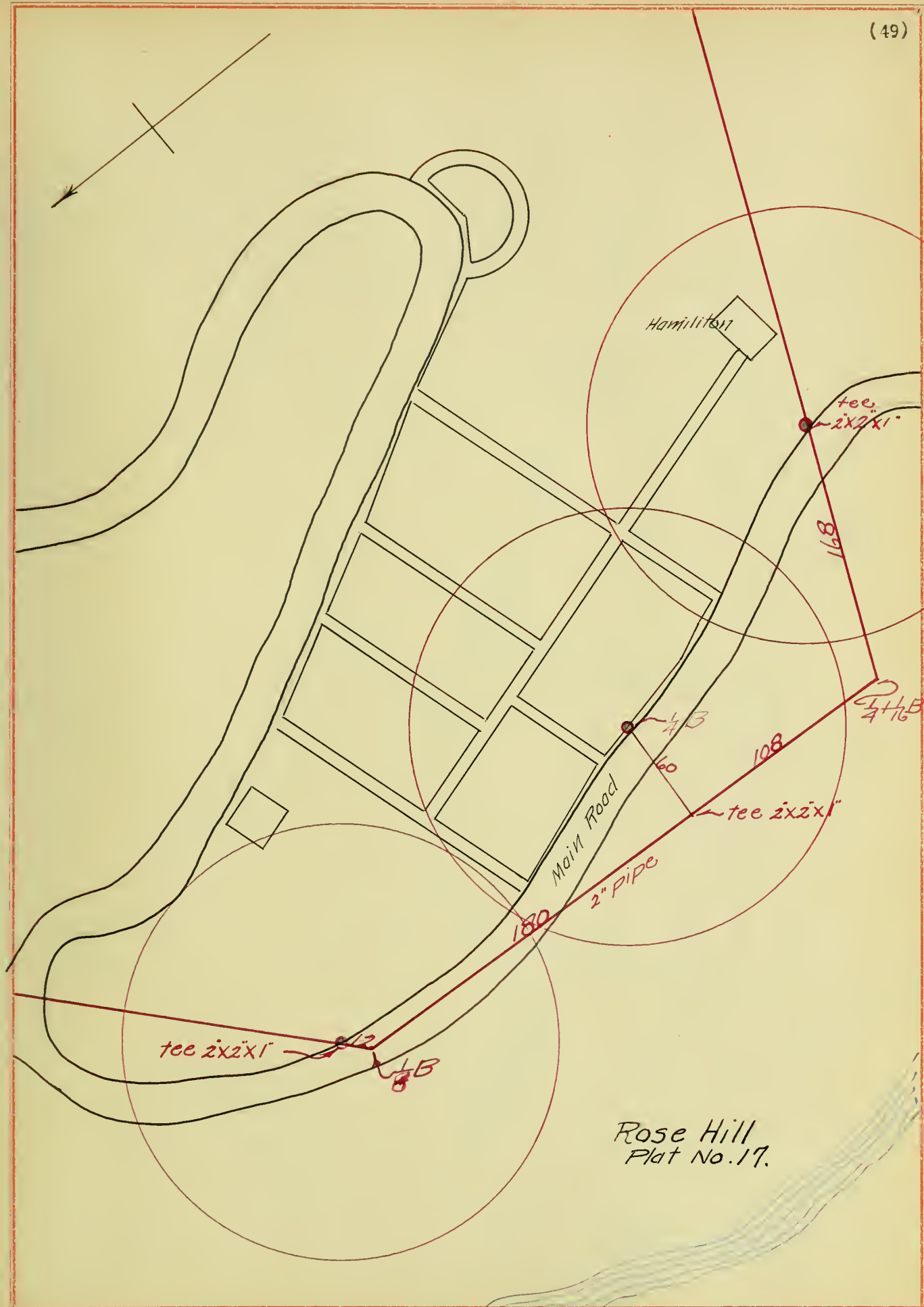




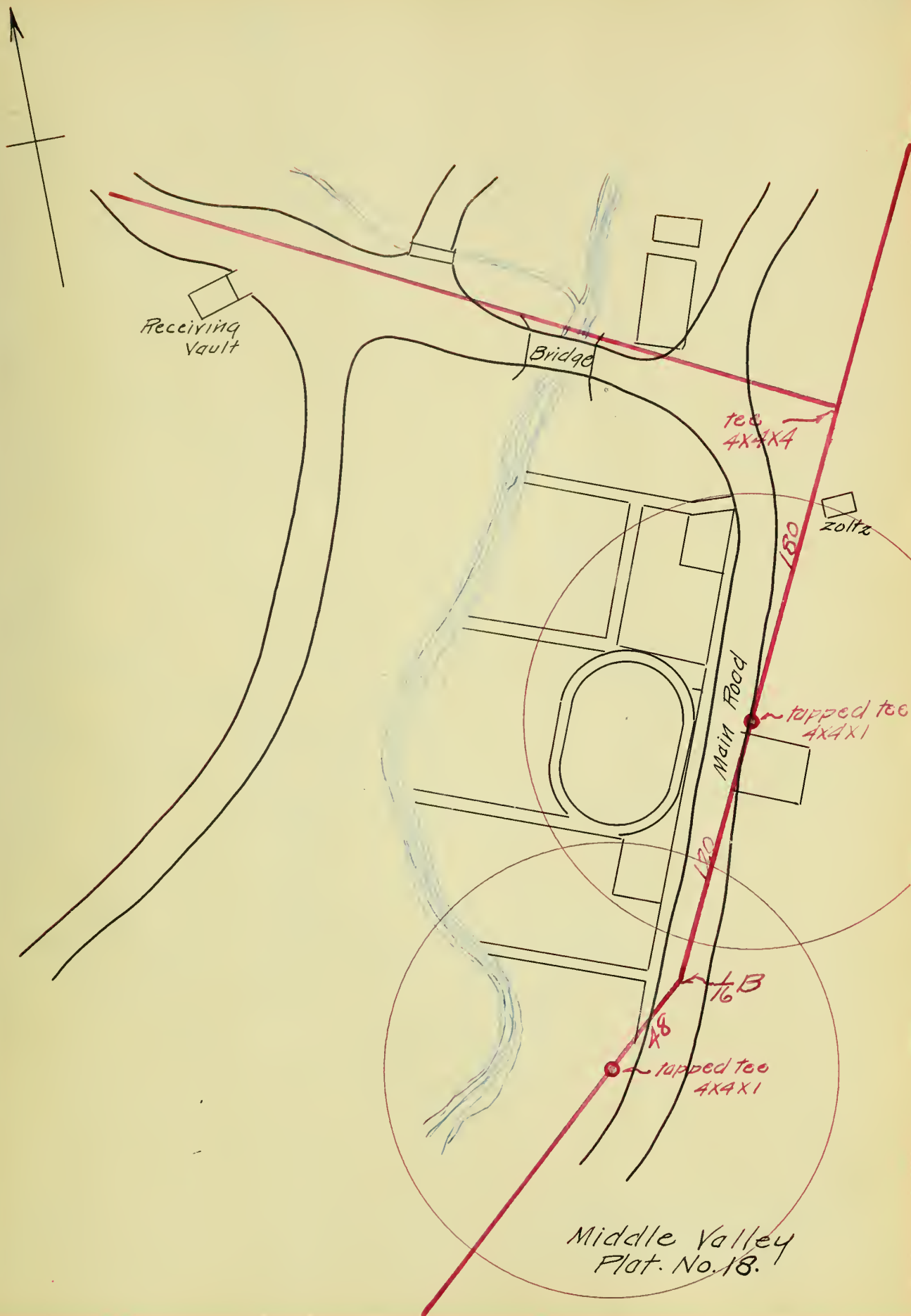






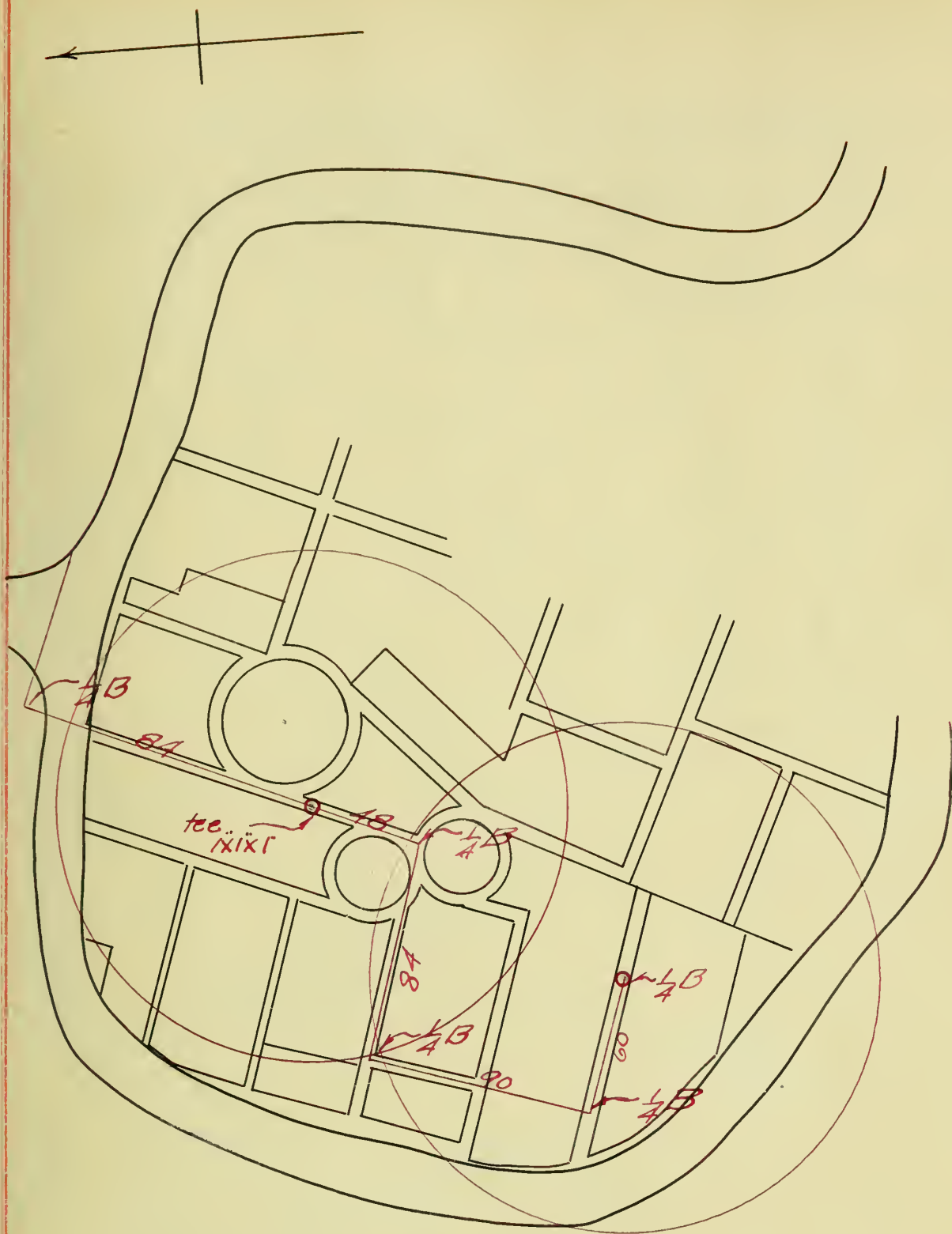






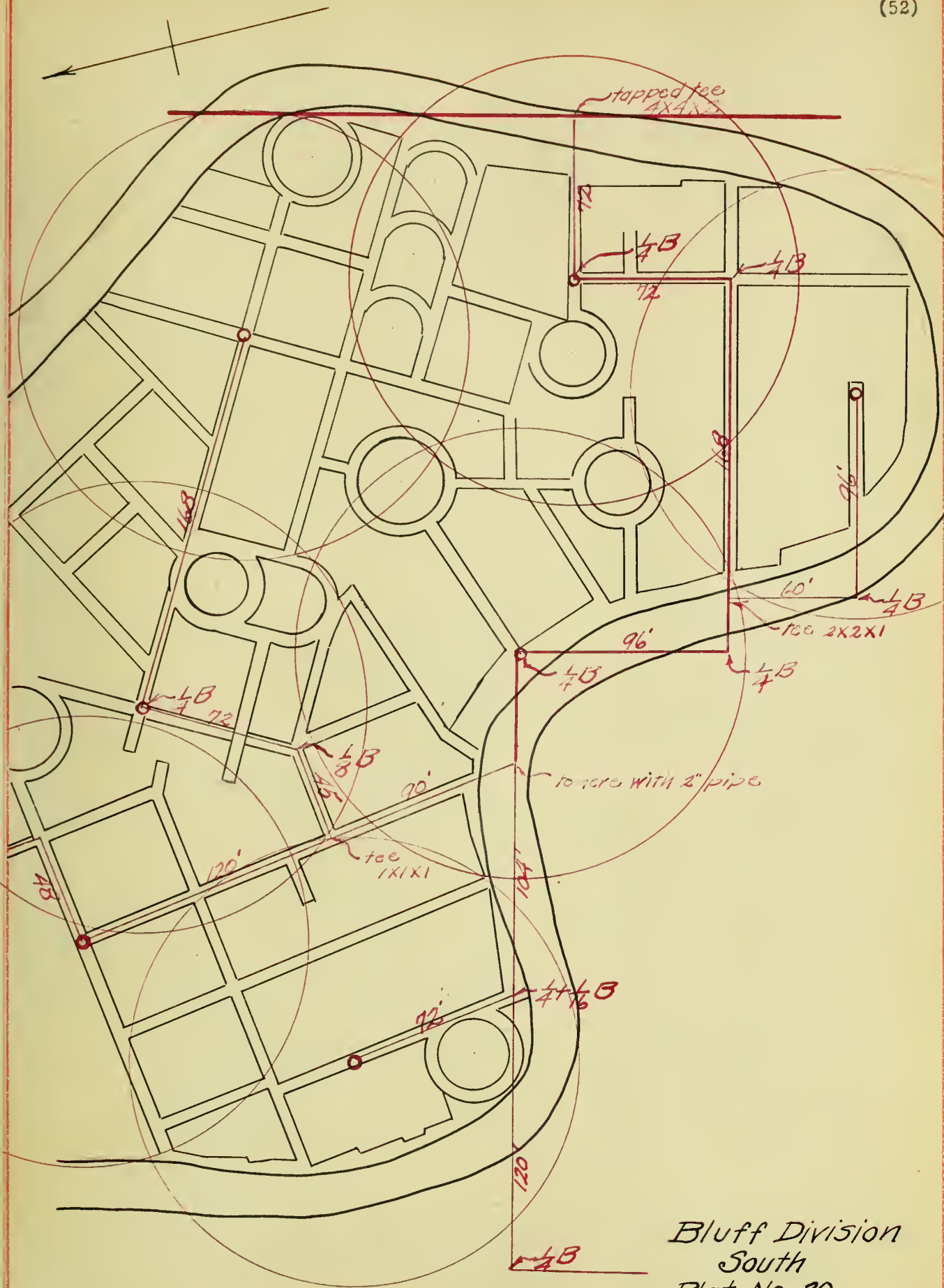






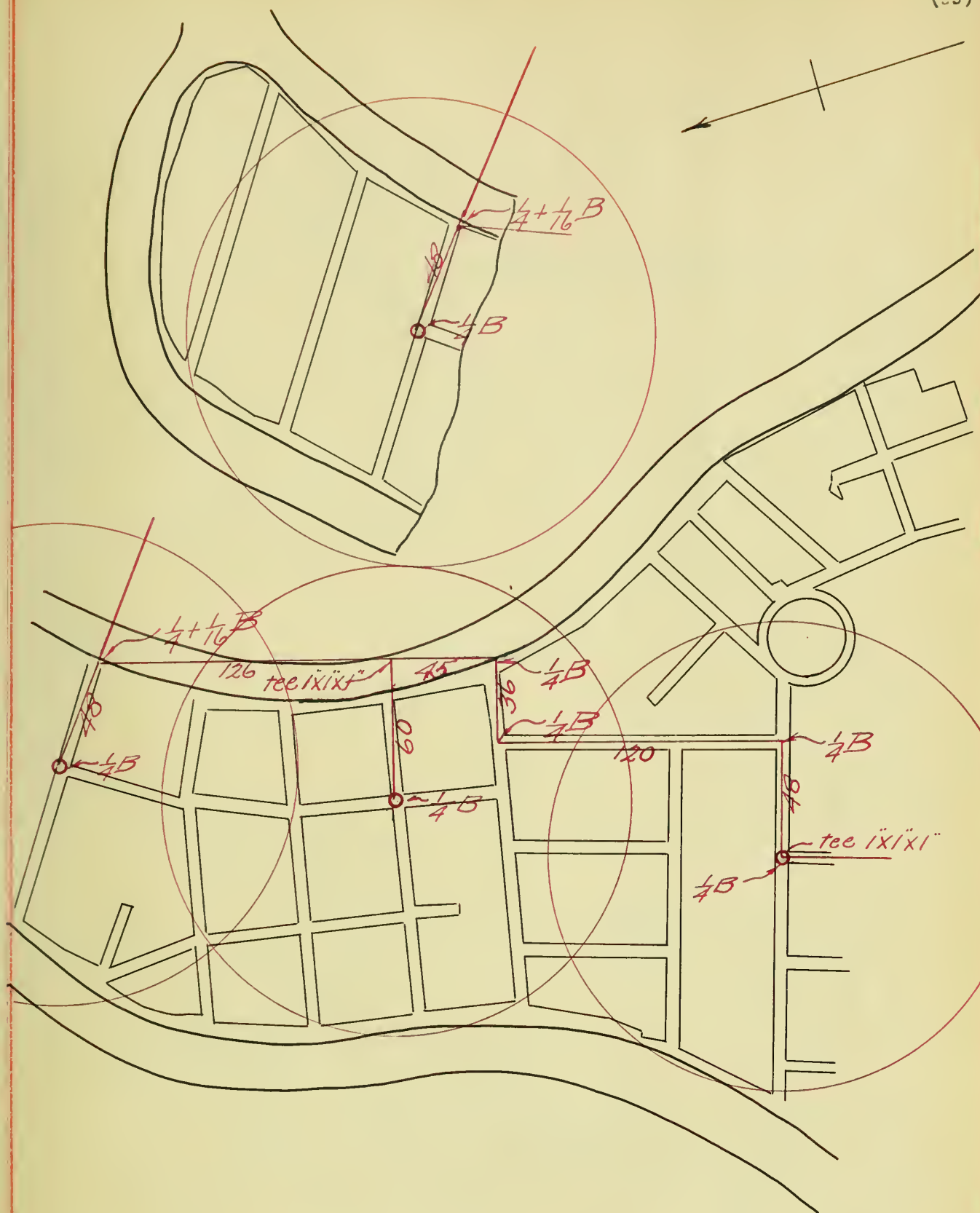
Greenwood Terrace  
Plat No. 19.





Bluff Division  
South  
Plat No. 20.

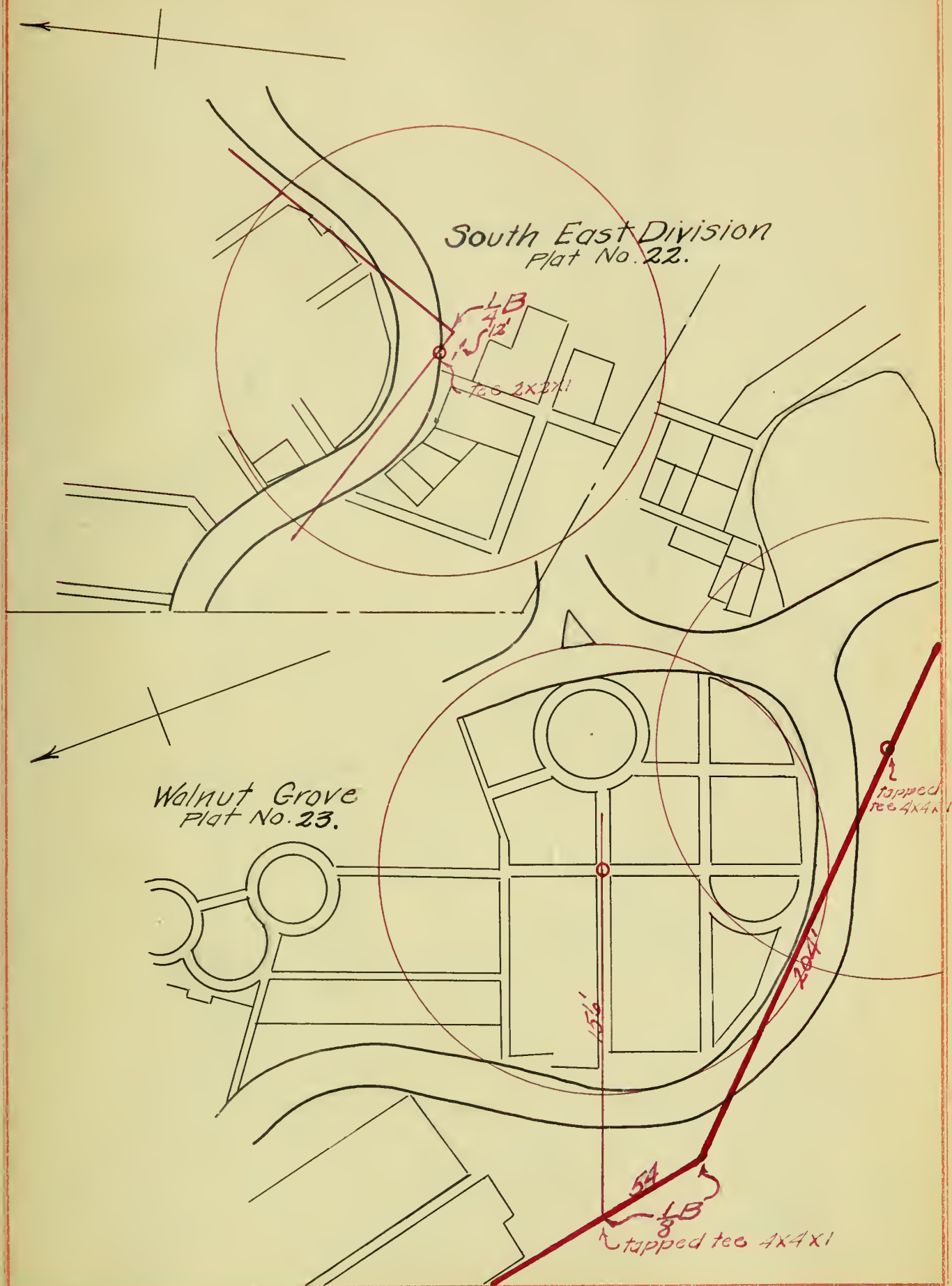




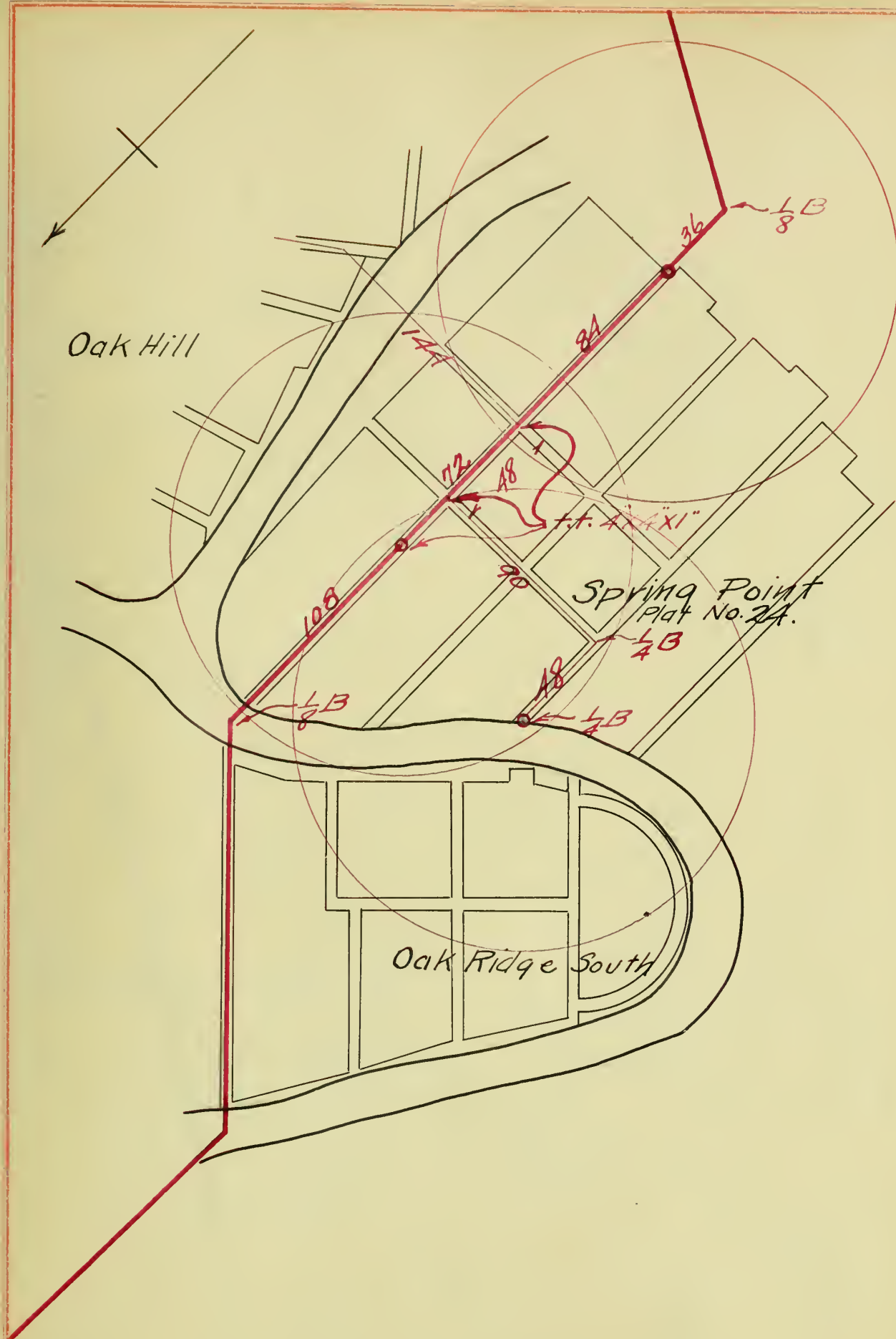
Bluff Division North  
Plat No. 21.

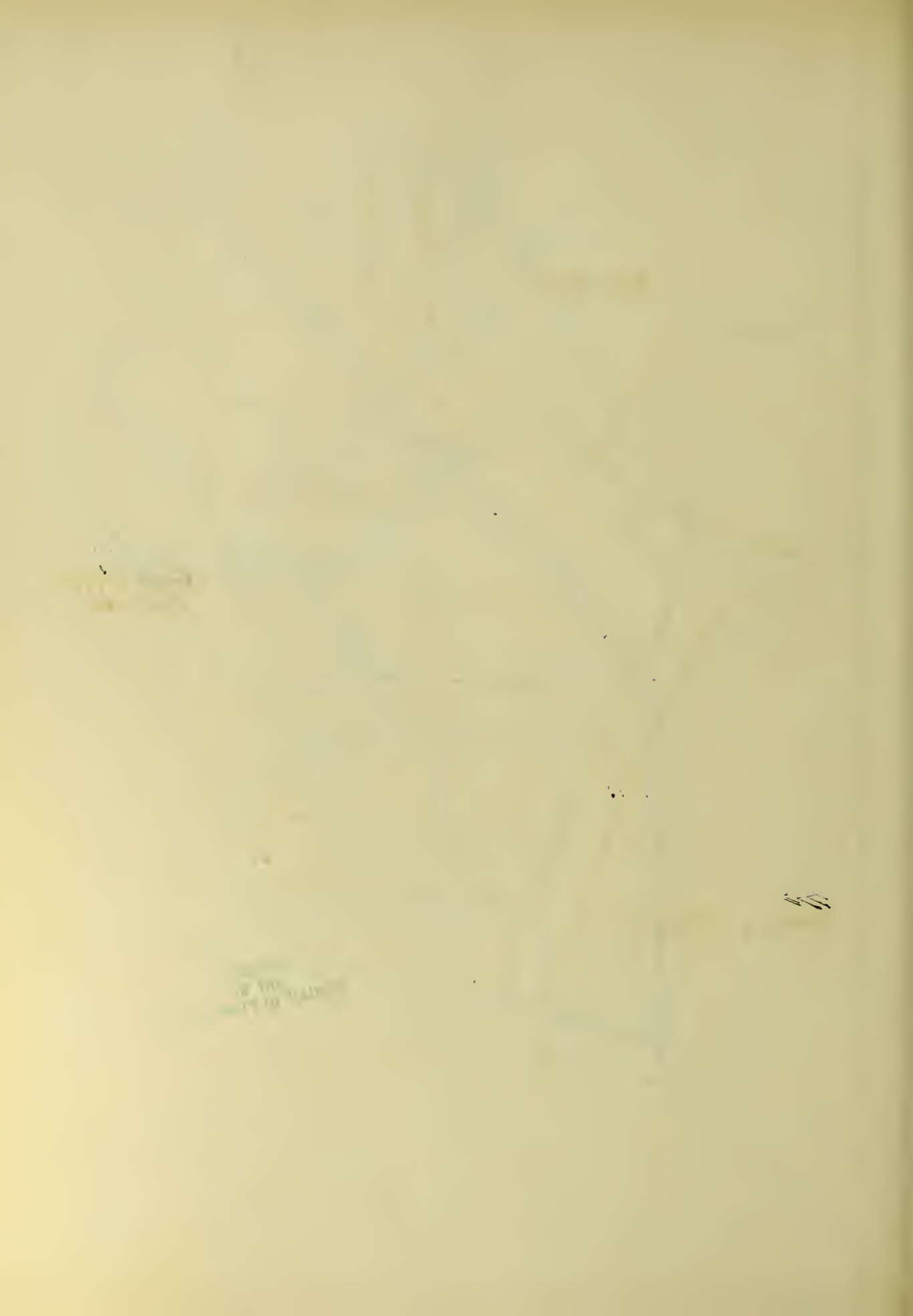


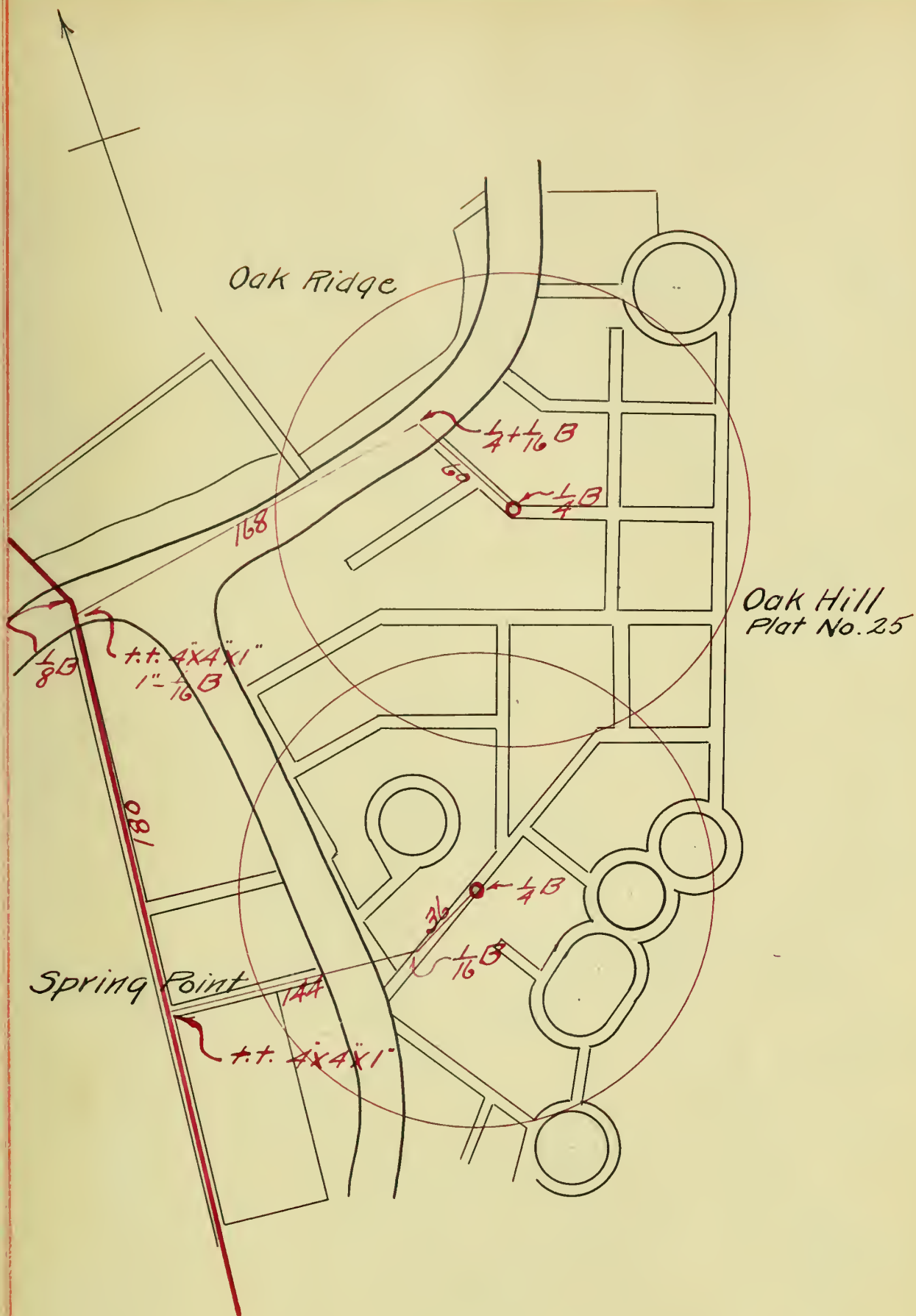






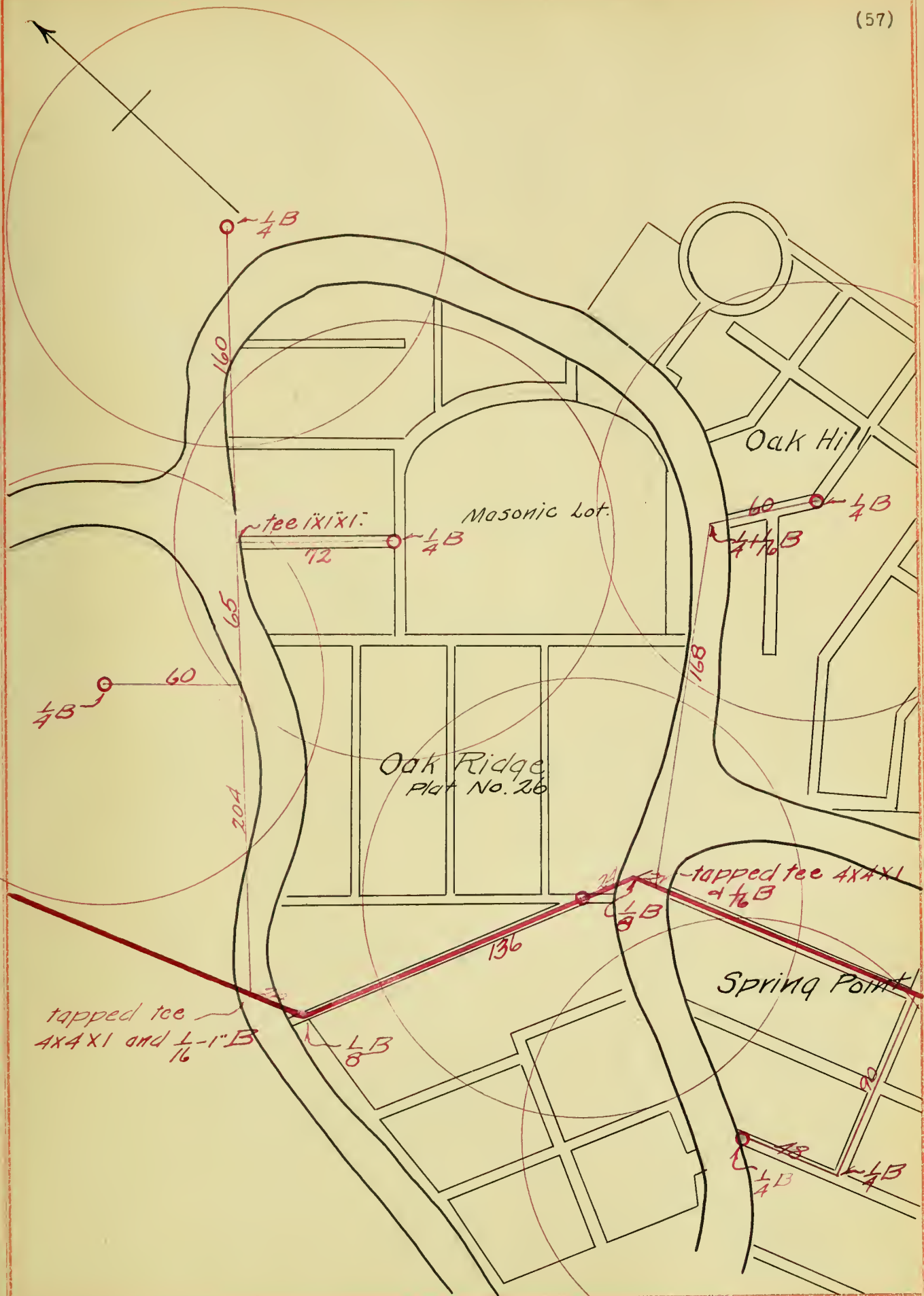




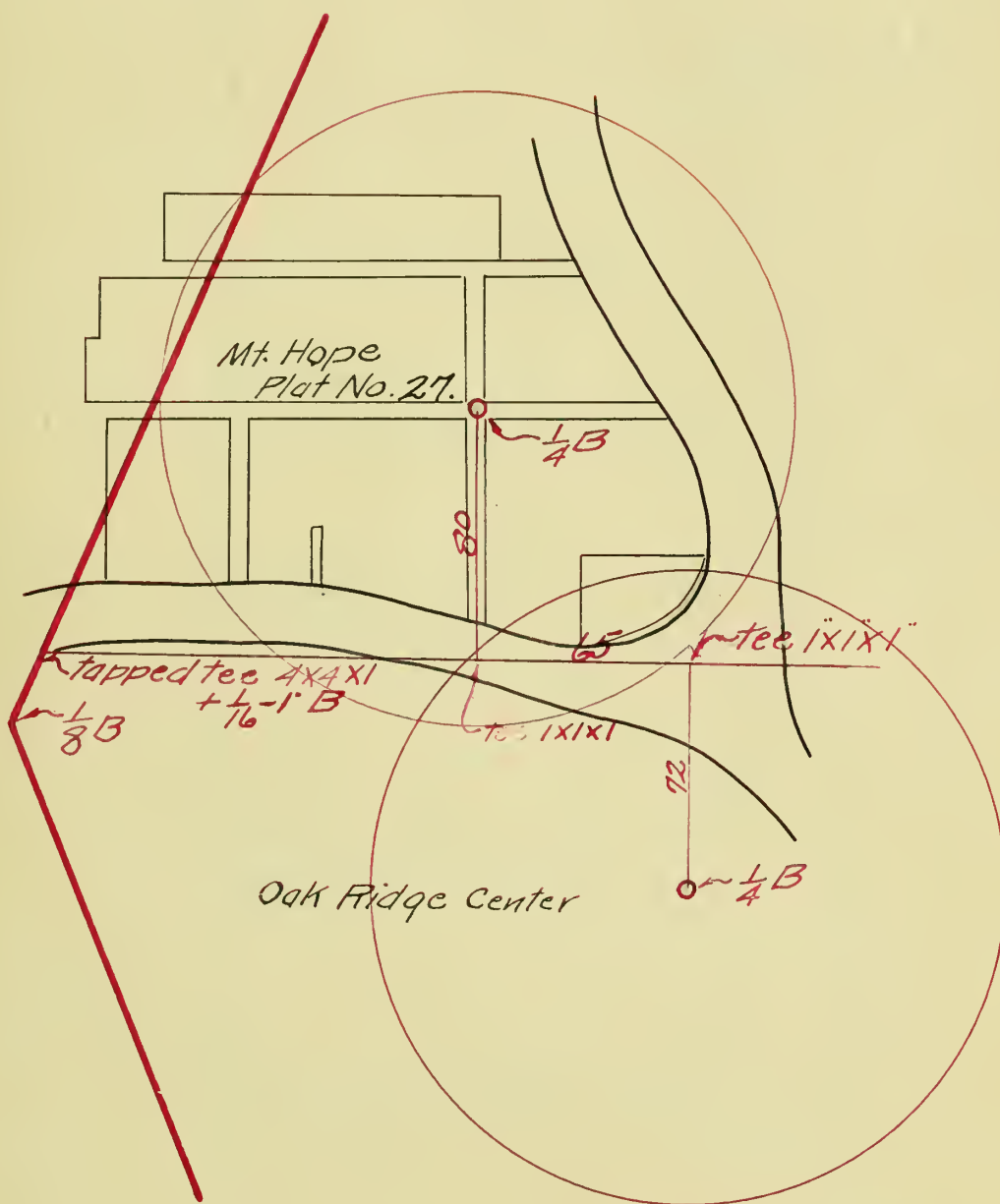
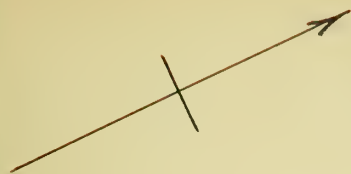




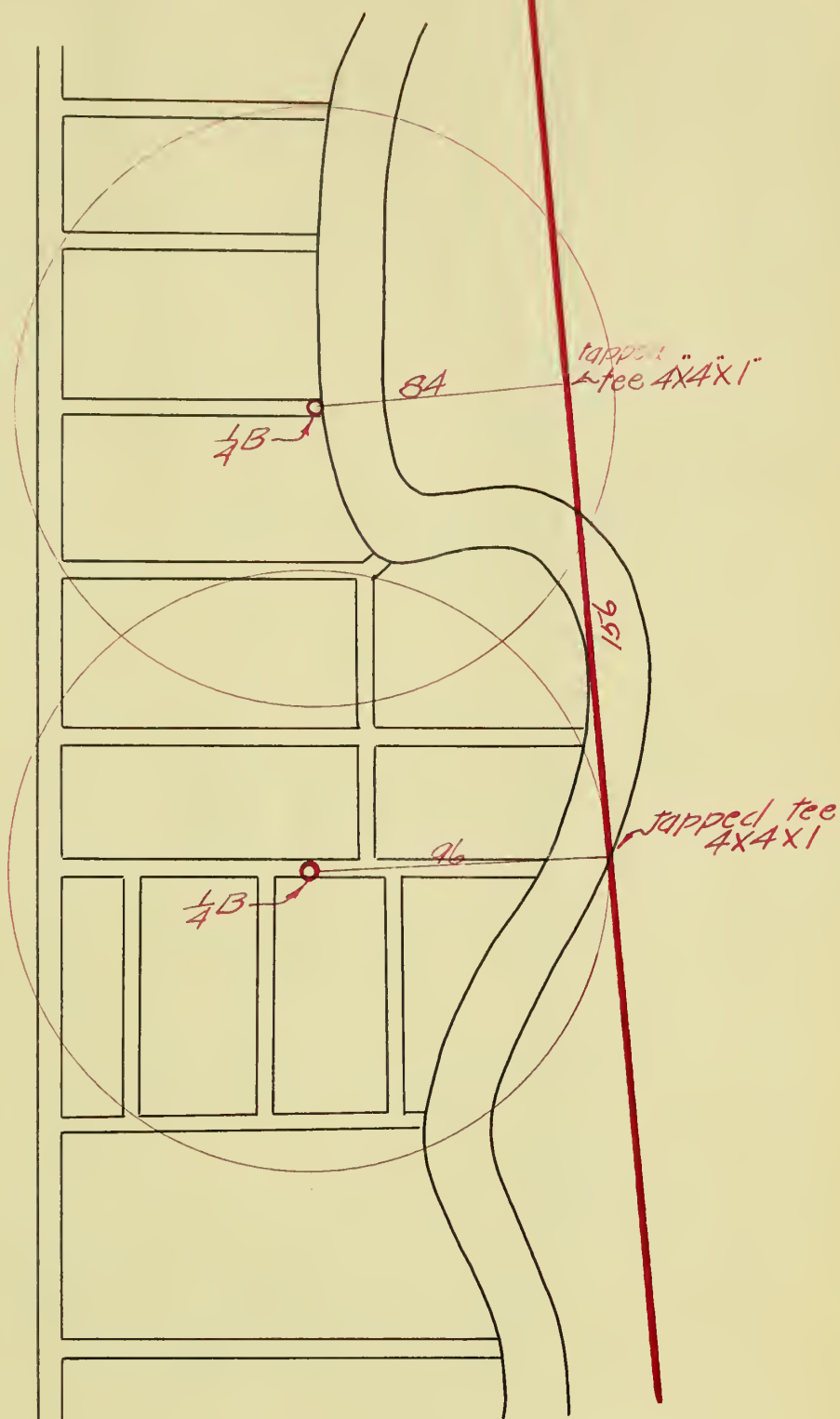








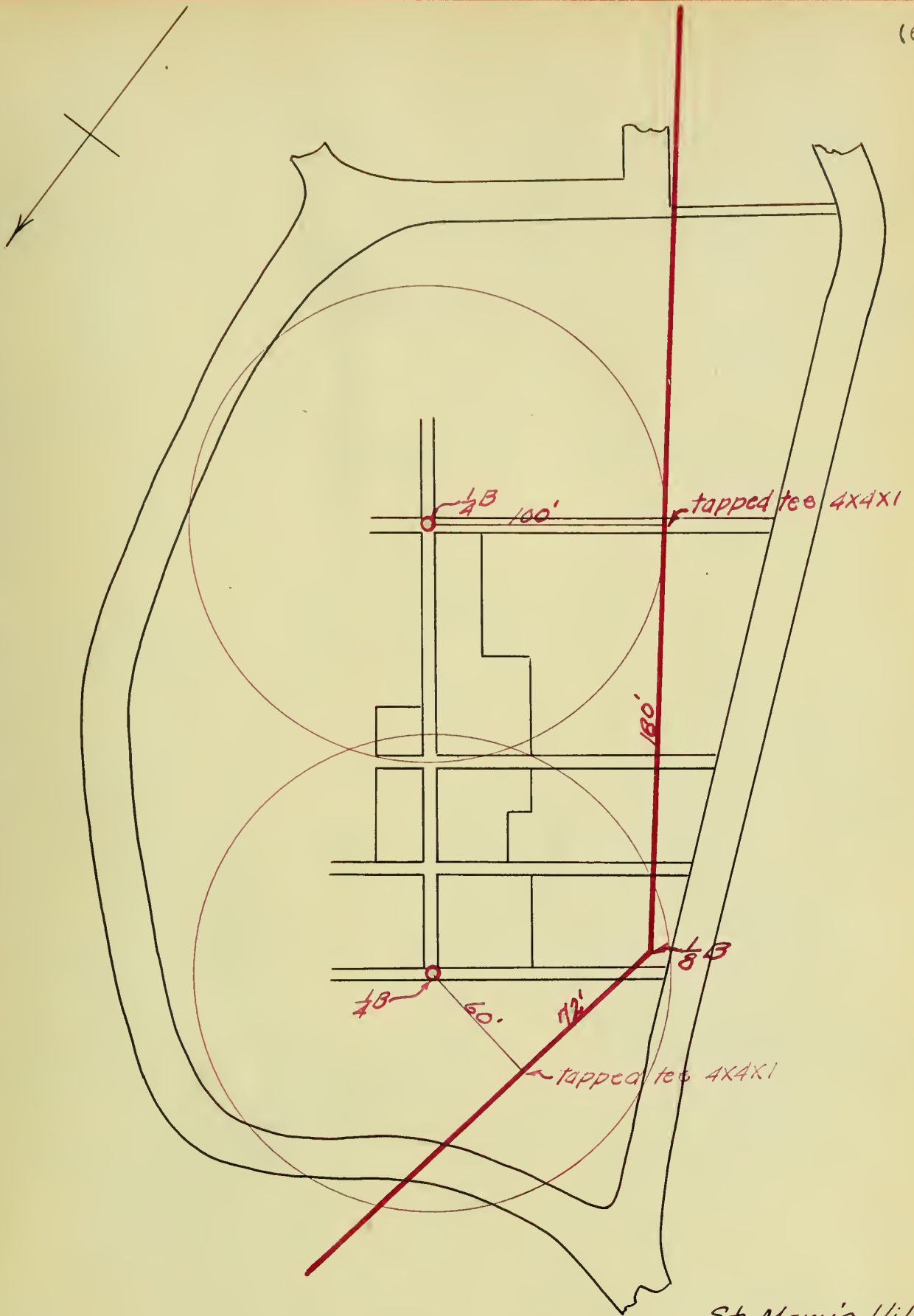




Mt. Sinai  
Flat No. 28

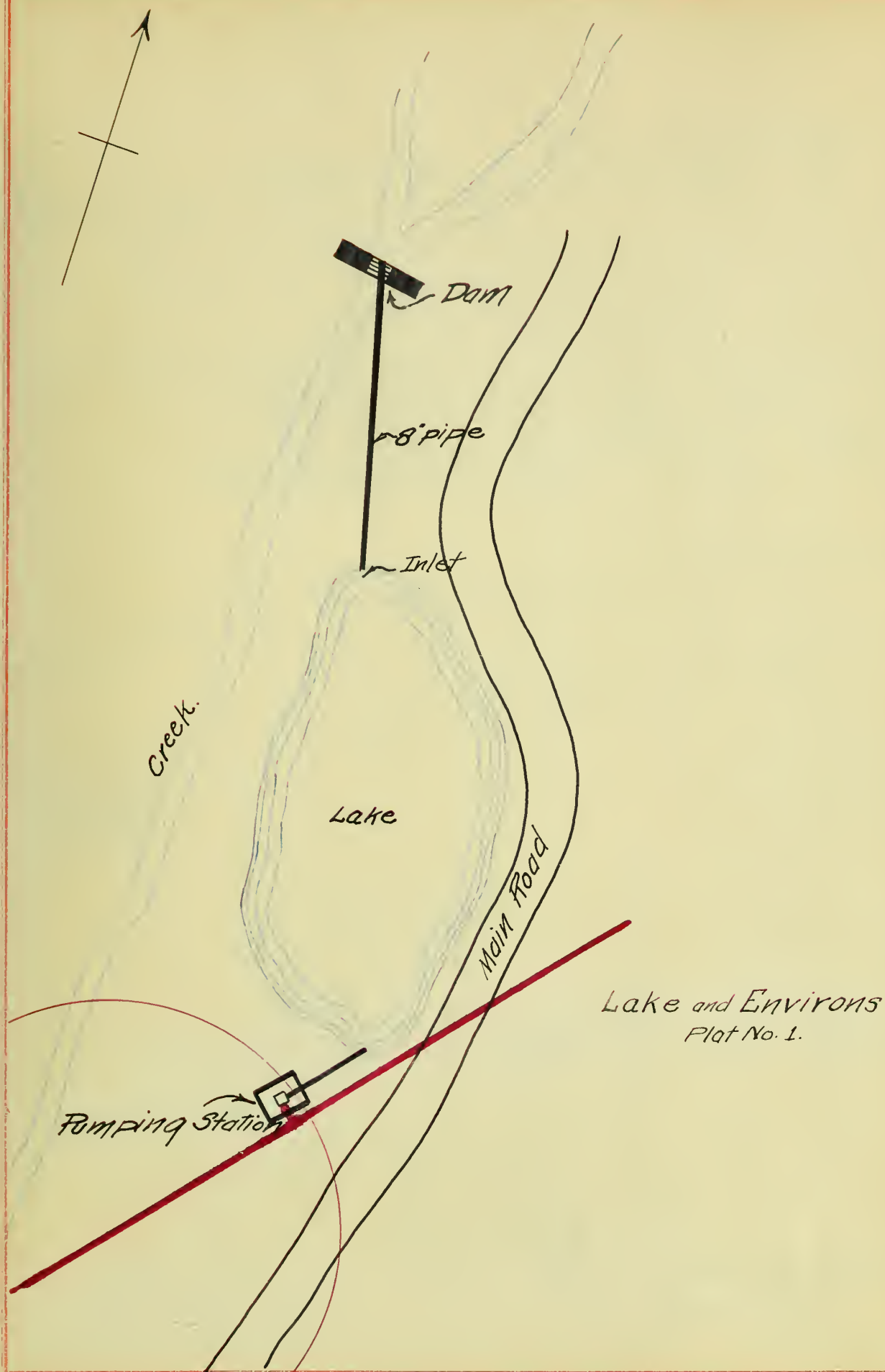




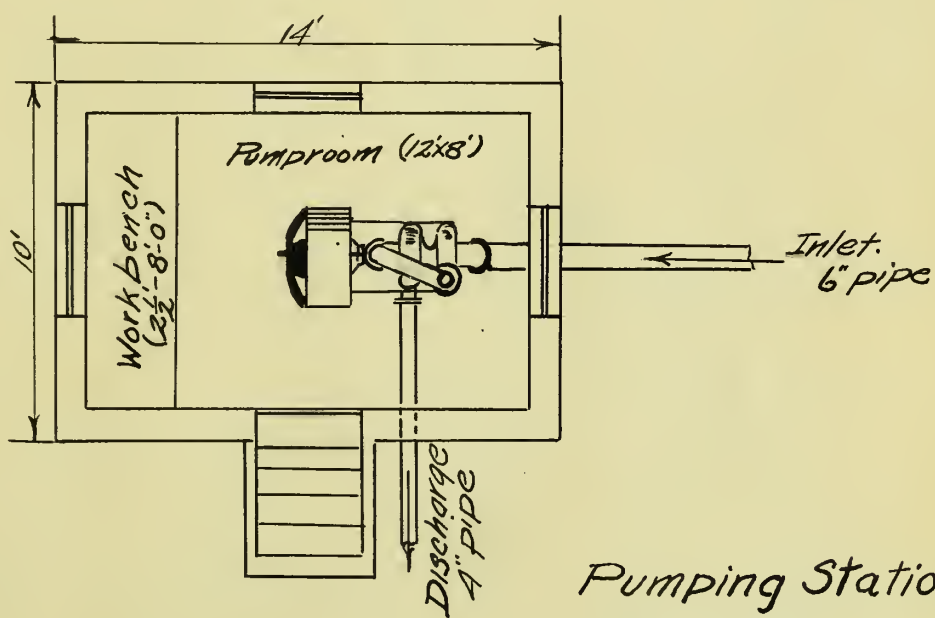


St. Mary's Hill  
Plat No. 29.





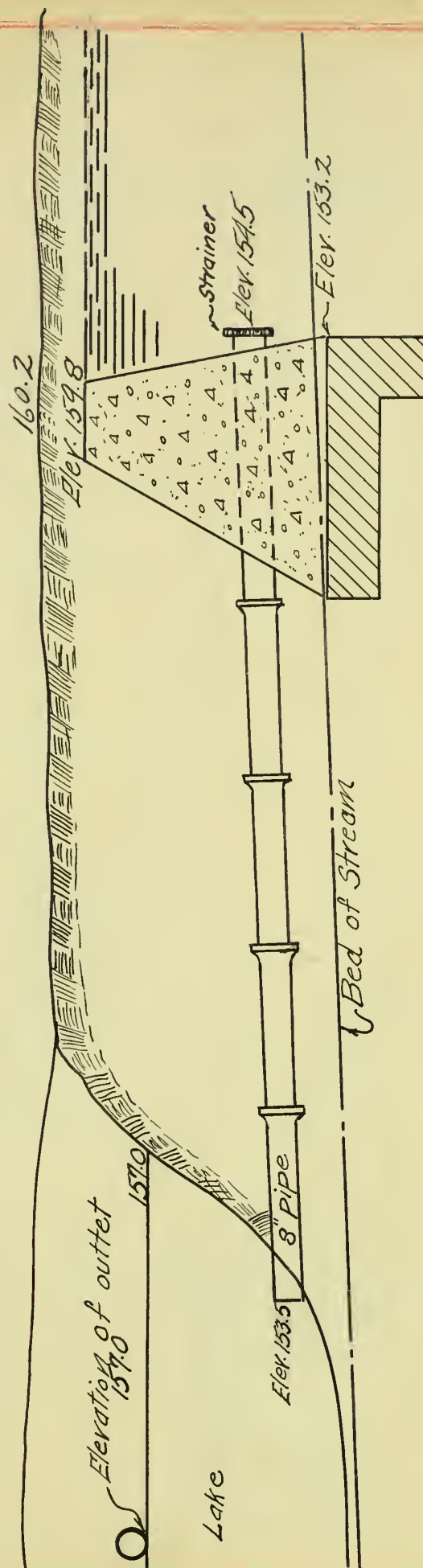




Pumping Station  
Springdale  
Cemetery

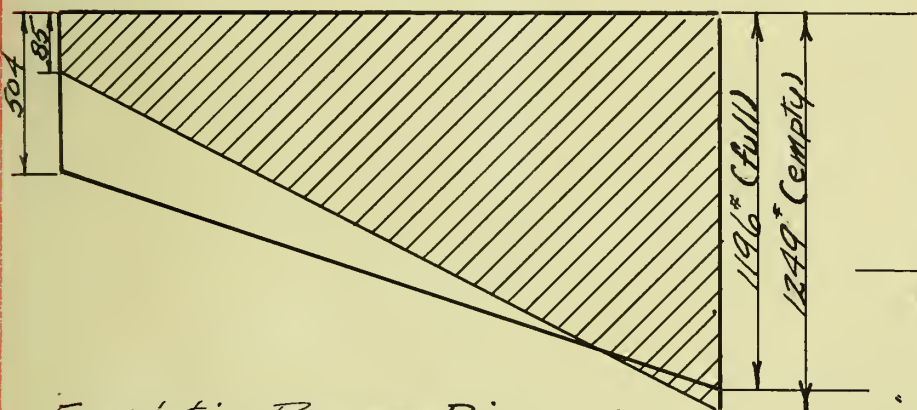
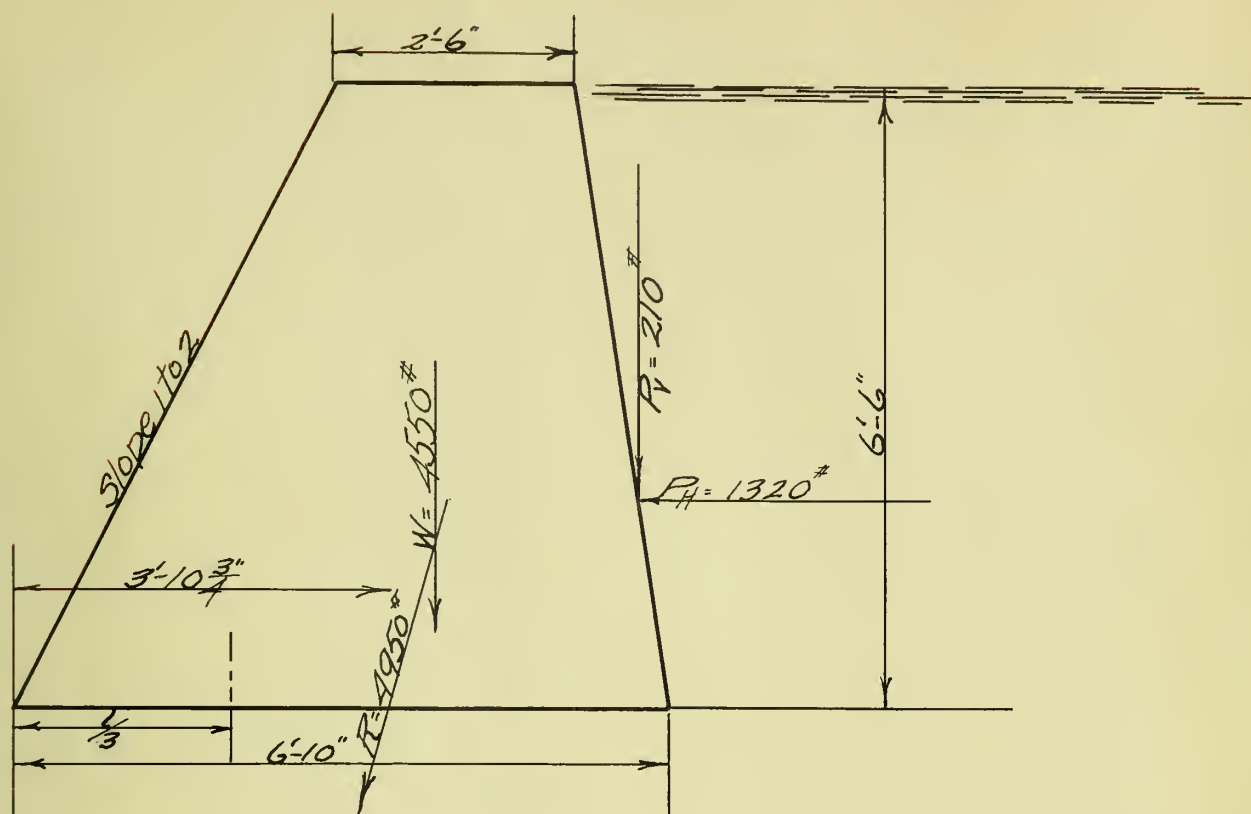




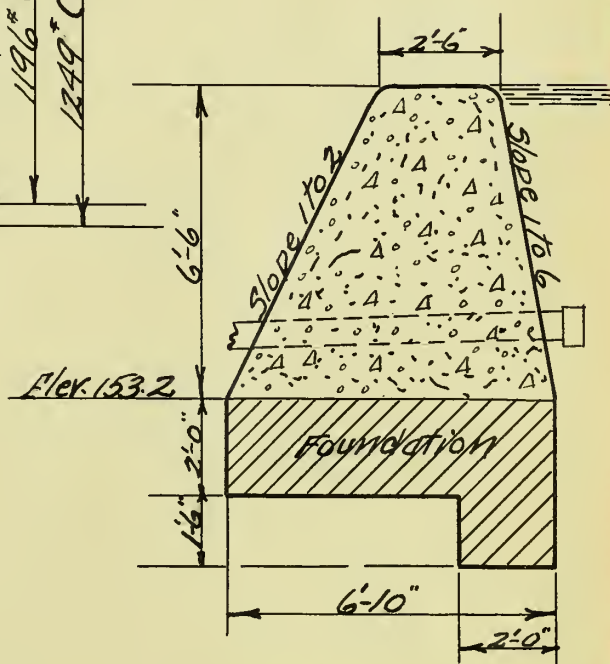




# Design of Solid Concrete Dam.

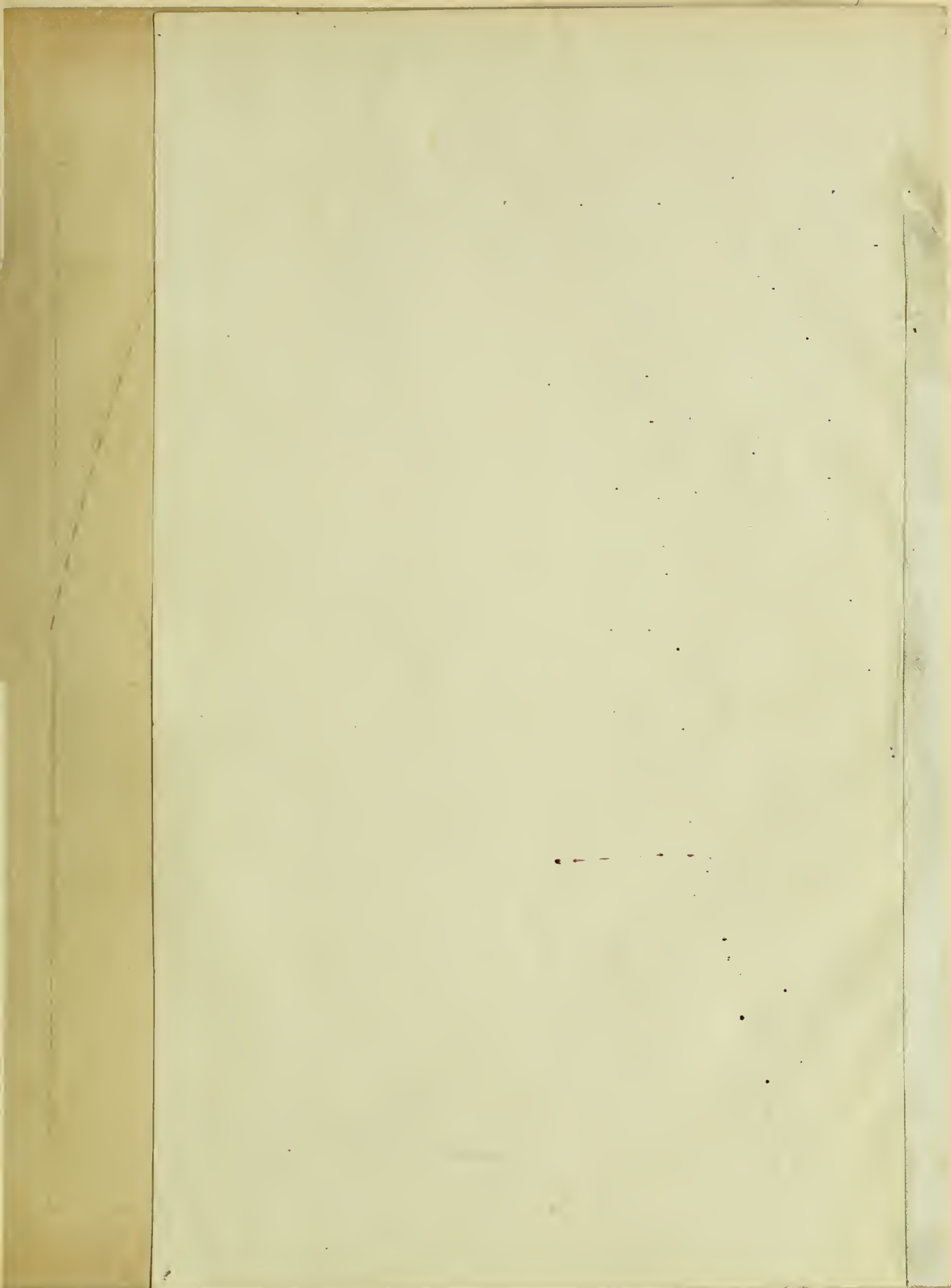


Foundation Pressure Diagram  
Scale (Vert.) 1" = 600'

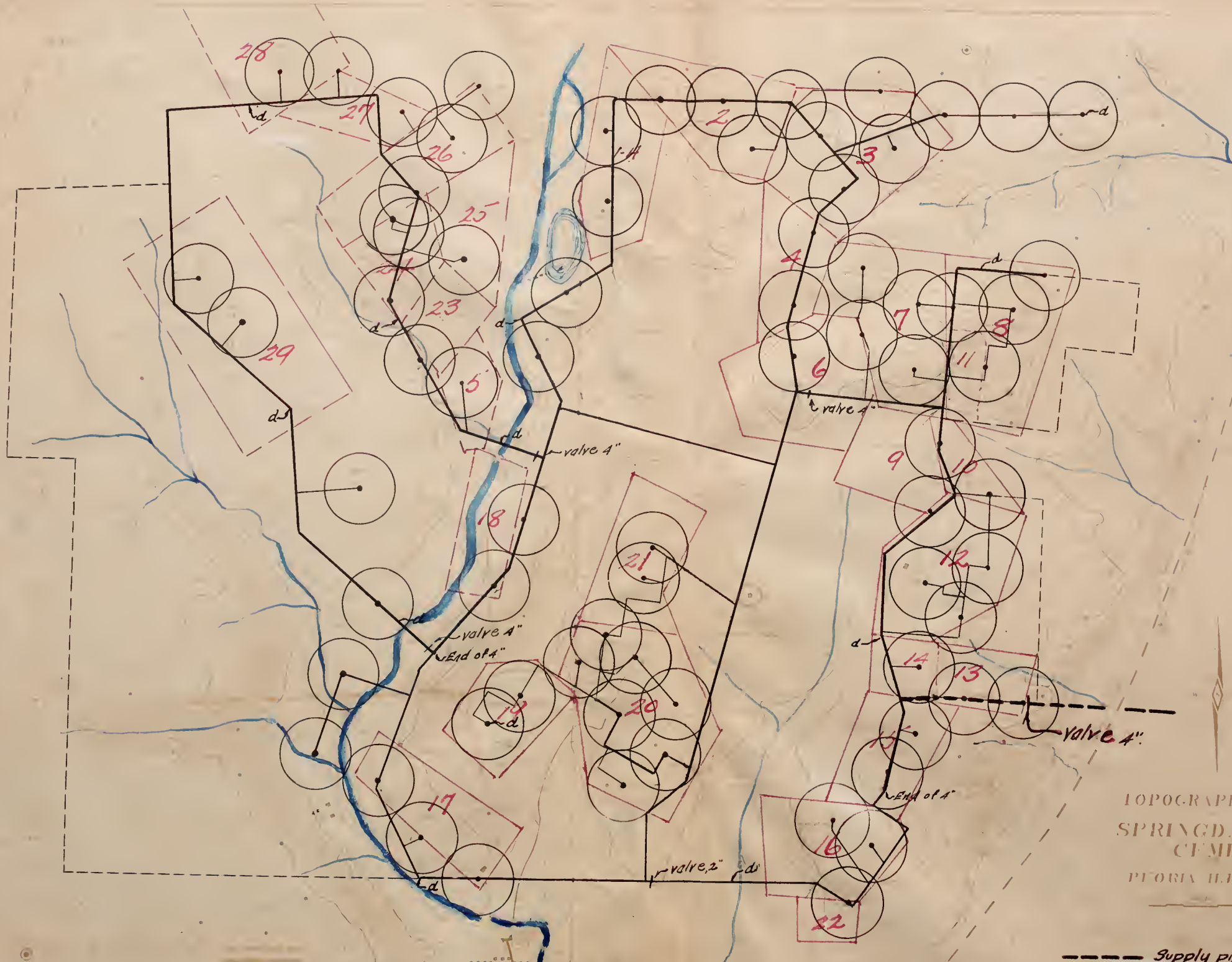


Cross Section









TOPOGRAPHIC MAP  
SPRINGDALE  
CEMETERY.  
PEORIA ILLINOIS.

----- Supply pipe to city mains.  
===== Distribution pipe 4 in.  
===== " " 2 in.  
===== " " 1 in.  
Note: - d = 2 inch drain.



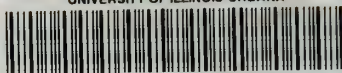








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